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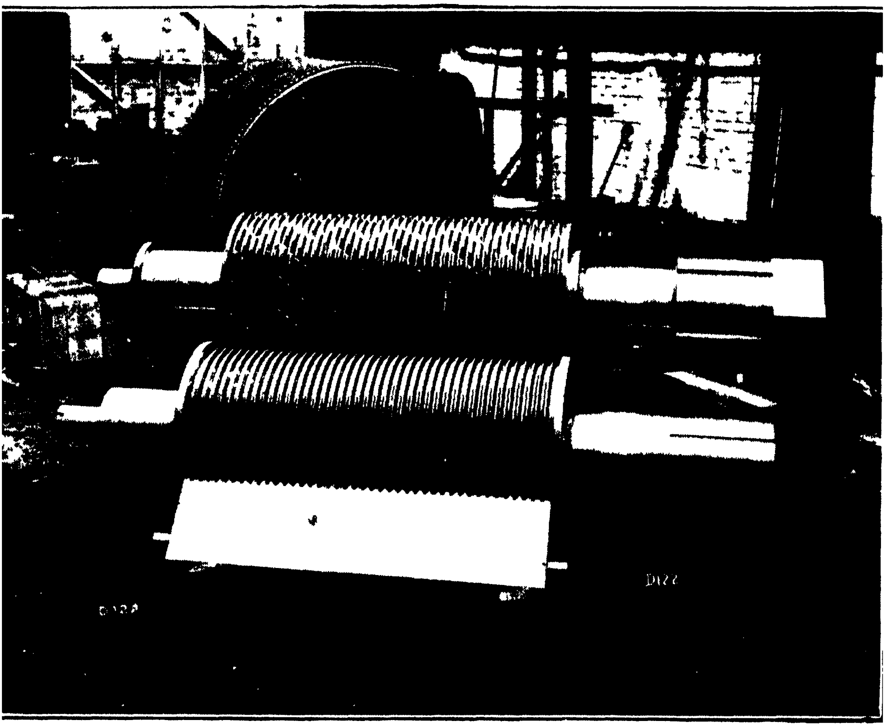

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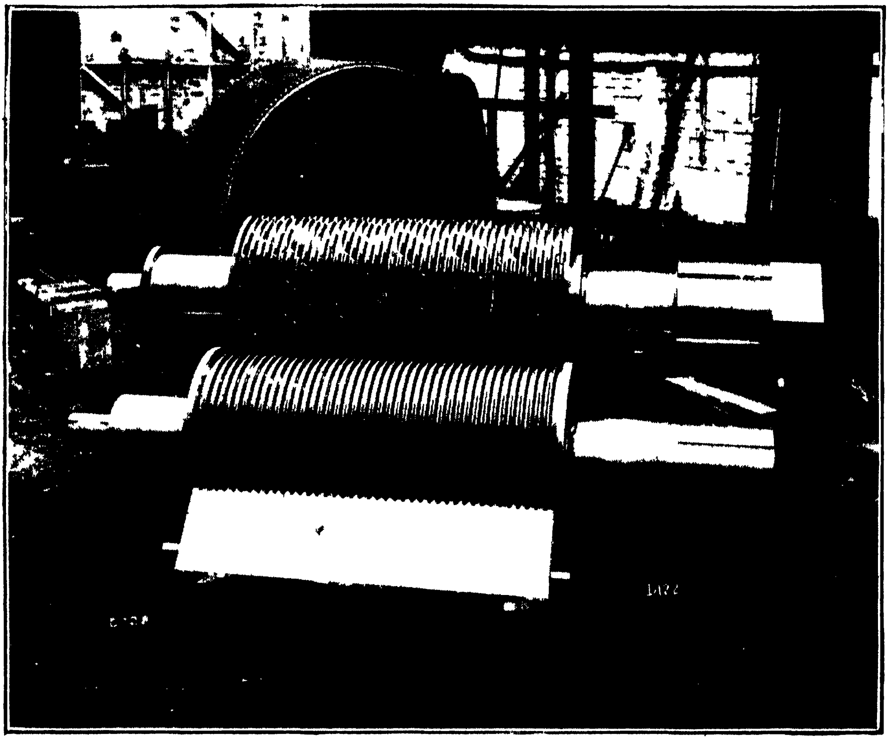

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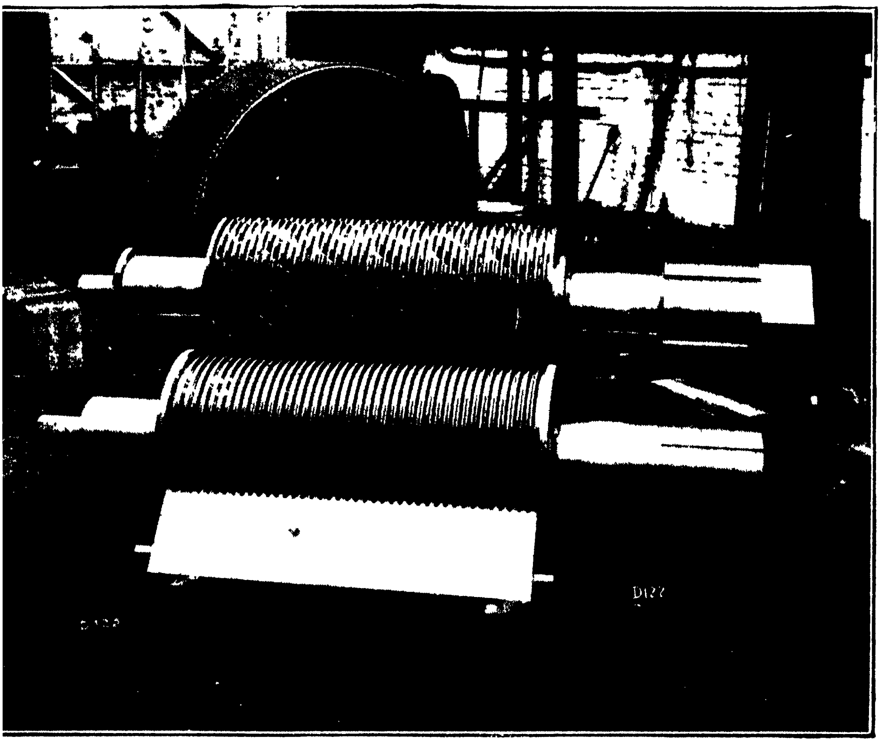

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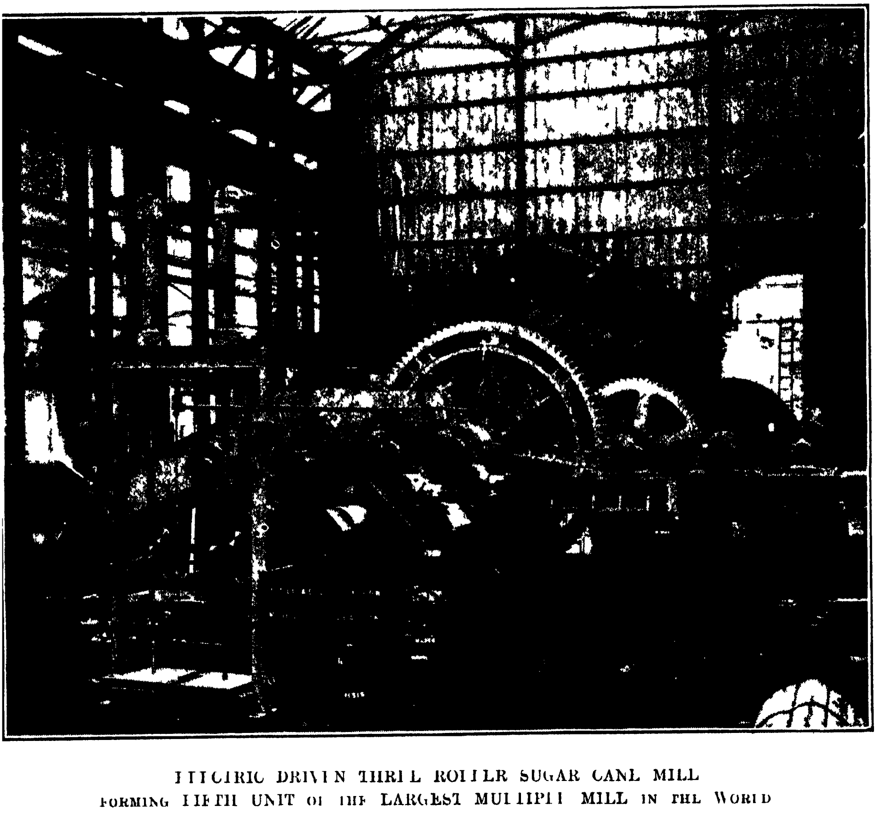

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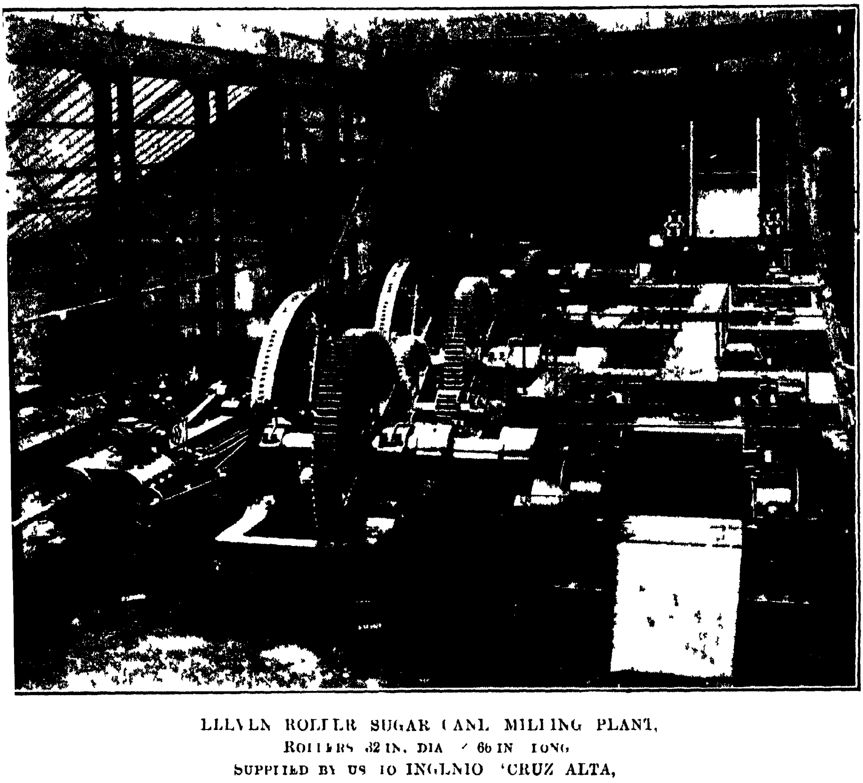

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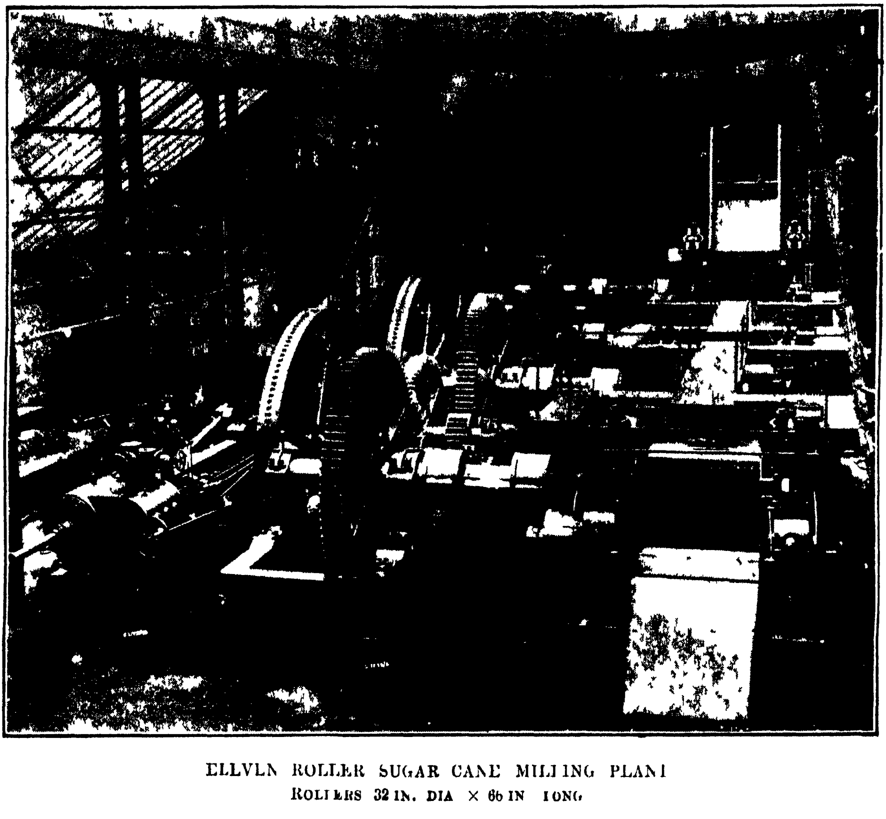

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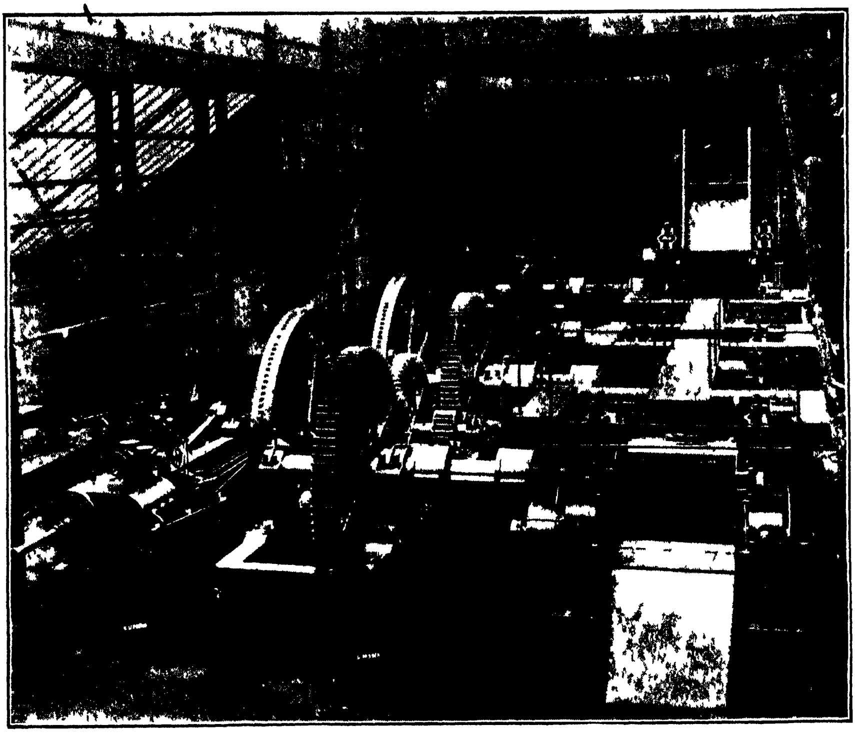

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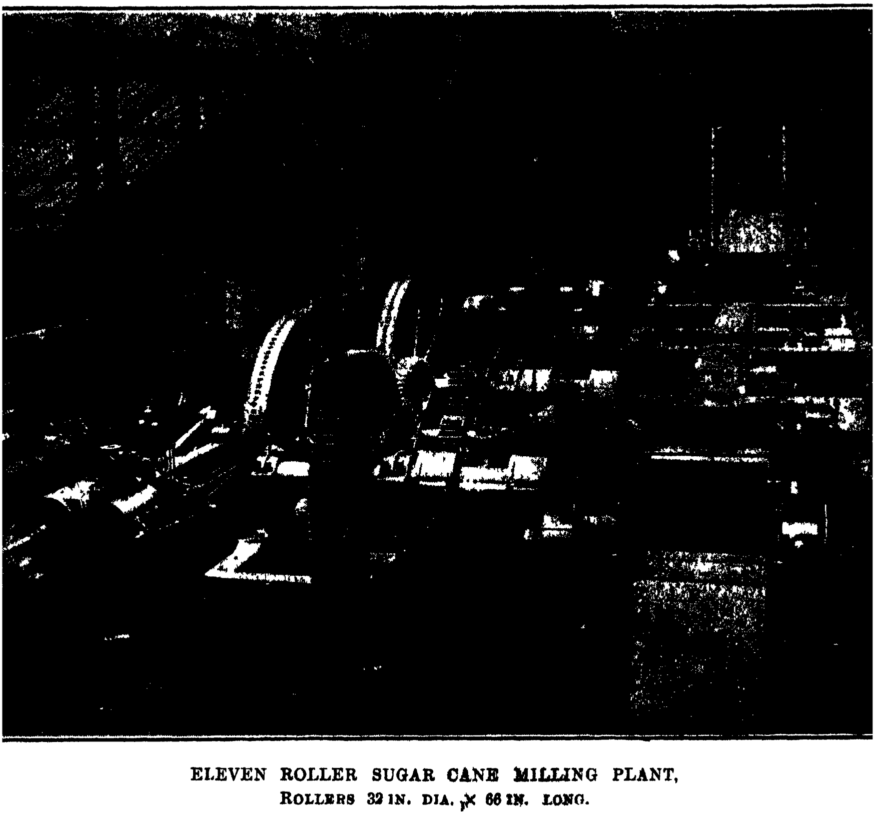

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No. 313. JANUARY, 1925. VOL. XXVII.

Notes and Comments.

The Beet Sugar Subsidy Controversy.

During the last few weeks a flood of limelight has metaphorically speaking been cast on the home-grown beet sugar industry both in Parliament and the press, and the subject has received unprecedented attention. Much loose talk and argument has been advanced as to the precise incidence of the new subsidy which, first proposed by Mr. SNOWDEN as Chancellor of the Exchequer in the late Labour Government, has been "stepfathered" (to quote a House of Commons phrase) by the present Government and will shortly pass into law. It is generally agreed on all hands (save of course those of doctrinaire Free Traders) that it is desirable to assist the nascent industry for a term of years ; even the refiners profess, in the words of Sir ERNEST TATE, to "have no objection whatever to the Government giving a subsidy on raw sugar"; the storm of controversy has centred round the question whether in granting a subsidy on the higher grades of beet sugar the Government is not inflicting a serious injury to the established refineries.

Unfortunately for the refiners, their protagonists in and out of Parliament are not by any means agreed as to the nature of the injury, and their case as presented in Parliament was too vague to be convincing, as the ten to one vote in favour of the subsidy assuredly proved. For one thing they will not state exactly what they want in order to remedy the alleged injustice. All we are told is that in not stopping the subsidy at the raw sugar stage the refiners are being most unfairly handicapped, and a good deal of play is made by means of loose arguments in the press to the effect that this handicap amounts to 21s. 8d. per cwt. ! [1]

The Pros and Cons of the Matter.

The above is the gist of the controversy. One must now examine not only some of the arguments employed but also the fundamentals of the case, if the whole is to be viewed in a right setting.

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[1] The only scale of subsidy published so far is that reproduced on page 11 ; but it may be pointed out that the difference between the subsidy on raw sugar at 94° and that on refined over 98° is a matter of some 3s. per cwt

To take the fundamentals first, the plain fact of the matter is that the refiners are up against something much bigger and more permanent that the question of an inequitable subsidy lasting under present intentions for ten years. This is neither more nor less than the cardinal fact that the production of sugar fit for table consumption is tending increasingly to become a single process, carried on in one factory with no intermission of operations. In beet sugar manufacture this single process is now in general operation in most up-to-date beet factories, especially in America where such a thing as raw beet sugar ever being offered on the market to the refineries proper is practically unheard of. It is probably quite accurate to say that all the U.S. beet sugar factories are producing white granulated sugar, without any raw sugar stage with its subsequent re-melting of raws. On the Continent of Europe things are more in a stage of transition; vested interests, and the existence of a large number of old factories, preclude any wholesale alteration in the *modus operandi*; but the tendency when modernizing old, or building new, factories is here also in favour of the one-process system, and it can only be a question of time ere the supply of 88 per cent. beet (at all events the surplus available for export) will tend to diminish greatly if not to cease altogether.

In the cane sugar industry the orientation is the same way, even though, owing to the more gummy nature of cane juice as compared with that of beet, scientific attainment has not advanced quite so far along the road to success. But it may be assumed that cane technologists have this aim in constant view and will not rest from their researches till the cane sugar factory also can turn out a perfectly marketable white sugar.

In view of these facts, it is futile, not to say misleading, for Sir ERNEST TATE to allege, as he did at the annual meeting of his Company, that "all sugar, "whether from cane or beet, must first be made into the raw product and we hold "that any subsidy to agriculture should stop there. The after refining is a further "process which can be more economically carried out on the larger scale in "refineries working all the year round." No doubt in the sense and practice desired by the refiners there are *two* processes, but as we have remarked above the latest modern practice is to combine them into one under the same roof.

The main question then is: Are we in starting a new industry in this country, an industry which is one of the most highly technical of its kind in existence, to handicap the beet sugar factories concerned, by making them handmaids to the existing refineries, or are we to give them *carte blanche* to adopt just that procedure as will prove most economical and remunerative for them in their fight against world-wide competition of the most up-to-date description? Mr. GUINNESS (the Financial Secretary to the Treasury) in his speech in Parliament (reproduced on another page) was clear in his view as to what the answer should be. Incidentally, he pointed out that the refining interests in their representations to the Board of Customs and Excise suggested as an alternative to the present official scale of subsidy that the scale should be adjusted to give more subsidy proportionately to unrefined than to refined sugar so that factories might be encouraged to produce the raw article which would have to be sent to the existing refineries for refinement. Now it is obvious that any such desire of the refiners to retain their monopoly at the expense of the home beet sugar manufacturers is not one that can be countenanced in the process of building u[illegible]is country a thoroughly modern beet sugar industry. The interests of t[illegible]wo are—for the present at all events—largely irreconcilable; and public o[illegible]n where properly informed is all in favour of giving the white sugar factories [illegible] hand. We are not prepared to commit ourselves at this stage to affirming that there is no means of compromise that will surmount the refiners' difficulties. But we affirm that the new factories must have the freedom to turn out just that type of sugar that it pays them best to manufacture, and if they get a subsidy at all it must not be scaled to penalize them in the matter of their given choice.

The Subsidy based on the Customs Scale.

Sir E. W. TATE stated, we repeat, that the refiners have no objection whatever to the Government giving a subsidy on raw sugar. Since then, the Secretary of the British Sugar Refiners' Association has declared that "they are not opposed in any way to any subsidy given to the home-grown beet industry, providing that such subsidy be given in a way not injurious to an existing industry." The clear assumption, then, is that what they object to is the granting of a subsidy to sugars polarizing over, say, 94°. But if we understand aright the arguments put forward in the House of Commons by Mr. GUINNESS (Financial Secretary to the Treasury), who voiced the view of the Board of Customs, the ascending scale over 94° is arranged after the similar scale of Customs Duties which increase with the rise in polarization on the basis of the fact that the higher the polarization the more sucrose there is in a given bulk of "sugar." The Customs aver that when the scale of duties was first drawn up, the refiners thought it erred on the side of assuming too high a recovery when one got near the top; now, when the scale of subsidy is drawn up on similar lines, the refiners assert that it errs the other way and unduly favours the finishing process. The refiners do not appear to have submitted any data to prove their case, and in default it is not surprising that for the present at any rate the Government are not convinced that the injustice exists to any appreciable extent. As is usual with Budget resolutions passed in the House of Commons, the subsidy will come up for a further stage of debate at a later date when the House will give the final legislative authority to the proposal. This will have to be before the end of March, and if by that time the refiners can demonstrate with some detail the actual effect of the subsidy on the refining industry, some eleventh hour concession might yet be obtained.

Refiners to embark on Raw Sugar Production.

The Government did make one concession to the refiners during the debate, which was that if they could get raw sugar from beet factories in this country, they would be entitled to claim that portion of the subsidy which was above the raw sugar stage. In other words, while that portion of the subsidy relating to say 94° went to the raw beet factory, the portion relating to all the polarization above 94° would be drawn by the refinery. We have often wondered why the big refiners have been so reluctant to come forward and finance schemes for producing raw material in this country for their refineries; in other words, to embark on the beet factory business at home and get a portion of the raw grades they refine from home sources. Their preference for raw beet as compared with raw cane is an open secret. Possibly they have counted too long on securing all their requirements in the future from Continental raw sugar sources. Comment was naturally made in the House of Commons on the fact of this reluctance. But now the force of events has decided them to take the step, and the leading firm, Messrs. Tate & Lyle, Ltd., have decided to co-operate with the Anglo-Hungarian syndicate which is starting a raw beet sugar factory at Bury St. Edmunds. We give the details elsewhere. The venue of this factory will doubtless allow the easy transport of the raw sugar in barges down the Essex coast and up the Thames to Silvertown.

This is a beginning which if successful is bound to be extended. It is all to the good that the refiners are being forced to give some attention to getting a portion of their raw supplies from home sources, to the advantage of the indigenous agricultural community. Independent factories will prefer as a rule to turn out the higher priced and therefore more profitable white sugar rather than 88 per cent. beet; they will need all the profit they can get because they will as a rule only work about 100 days a year. But the refiners who own beet factories can average the profits of the latter with those of their refineries working with beet or cane all the year round, and to that extent will have some advantage over the white sugar factory owner, who is not yet assured of continuous employment for his plant. To refine raw cane sugar in a beet factory after the termination of the beet campaign would probably not be an economical achievement, as such factories are at present equipped, though there remains the future possibility of such refining being economically undertaken by means of a process using some decolorizing carbon.

The *Modus Operandi* of a Beet Sugar Factory.

As we stated above, it is not the case as suggested by the refiners that the making of white granulated beet sugar is necessarily a two-process job. In modern beet factory practice, white sugar is produced in a continuous process without re-melting, that is without the production of any intermediate raw grade. In other words, *white granulated sugar can be produced directly from the concentrated clarified juice.* This is the standard practice in the United States where the white granulated beet competes with output of the seaboard cane sugar refineries. It would also appear to be the process to be used in the latest beet sugar factory to be started in this country, viz., that of Colwick, the property of the Anglo-Scottish Beet Sugar Corporation, Ltd. In an illustrated booklet on this factory issued by the Corporation we are shown by means of a flow sheet that the operations following evaporation are as follows: filtration through sand; boiling to grain in the first vacuum pan; mixing; centrifugalling; discharging white crystals; drying; cooling; and finally transporting to the finished sugar bin and ultimately to the store, the molasses being of course boiled and the second sugar also worked up to white sugar. This factory has been equipped with machinery by Messrs. Duncan Stewart & Co., Ltd., of Glasgow, and as this firm are also equipping the Spalding and Kidderminster factories, it may be presumed that these also will adopt a similar scheme of operations.

The Greenock Refining Industry.

It is an unfortunate circumstance that just at the moment when the competition between the established refiners of Great Britain and the nascent white beet sugar industry is in the forefront of public notice, the old-established Greenock sugar refining industry should have suffered a severe eclipse resulting in the permanent closing down of the refinery of Messrs. NEILL, DEMPSTER & NEILL. Various factors have contributed to this contretemps. The most immediate one has been a prolonged strike lasting some months on the part of the refinery workers for increased wages. When the strike was finally settled for the time being, the workers found there was no further work in one refinery while the others will be closed till February or March for lack of supplies of raw sugar. Apart however from the strike, other causes have contributed to the difficulties of the Greenock refiners. The increasing competition of Continental refined in our markets, the difficulty of getting their accustomed supplies of 88 per cent. beet[1] which has necessitated their buying increasing amounts of raw cane from Cuba at prices which on a falling market have proved unremunerative, and the fact, doubtless, that they have, as far as modern refinery practice goes, comparatively small outputs—all these circumstances have rendered a profitable refining business a matter of increasing difficulty and the dislocation caused by the strike doubtless decided the private firm of NEILL, DEMPSTER & NEILL to retire in good time.

This business has been in existence for 71 years. NEILL, DEMPSTER & NEILL has been a household word in Greenock sugar circles, and we join in the general regret that has been expressed that this firm—which must be one of our oldest subscribers—should have been forced to terminate its activities. There was a time when Greenock possessed no fewer than 24 refineries, but now the number is reduced to four. It is to be hoped that these survivors will be able to tide over the present economic crisis that has visited their industry in Greenock, and so maintain the old associations of that town with sugar.

Home Grown Sugar Beet Seed.

Experiments in the home-production of sugar beet seed have now been carried out by the British Beet Sugar Society for the last three years, under the supervision of Dr. VOELCKER, and with the advice and assistance of Mr. ARTHUR SUTTON (of Messrs. Sutton, Reading), and Messrs. Kuhn & Co. the well-known Continental sugar beet seed producers. In 1922 "stecklings" or small beets were produced from the best "mother seed" obtainable on the Continent. In 1923 commercial seed was produced from these transplanted beets. This year the seed so produced has been sown by 17 experienced growers in 11 counties, and the beets grown therefrom are in process of delivery to the factories where the net yield per acre and the sugar content in the beets will be ascertained on behalf of the Society. The result will be compared with the yield and sugar content of home grown beets from commercial seed produced abroad from "mother seed" of the same stock. A further stage in the experiment is now under the Society's consideration.

The Jeswiet Method of Identifying Cane Varieties.

On another page we give a paper by Dr. EVA M. DE CALVINO, Chief of the Department of Botany at the San Manuel Sugar Cane Experiment Station, Oriente, Cuba, containing a reasoned criticism of the JESWIET method of identifying sugar cane varieties based upon the distribution of the hairs found on the outside surface of the buds, sheaths and leaf blades. This paper is thoroughly scientific in tone and treatment and represents far more work than would appear at first sight. The task of distinguishing over 60 zones of hairs in an object usually about one-third of an inch in diameter is one of extraordinary minuteness, and it is probably owing to this fact that very few criticisms of the JESWIET method have as yet appeared, The latter may be considered a remarkable "tour de force," yet it is one that stands in need of a good deal of confirmatory evidence before its assumptions can be established, and modifications of the original theory are bound to be found necessary. One therefore welcomes a contribution to the argument from a skilled worker like Dr. DE CALVINO.

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[1] It should be pointed out, however, that one Greenock refinery, the largest, has always used cane sugar only.

The important point brought out in her paper is that the presence or absence of hairs is one of the characters most affected by climatic conditions, especially moisture. Although there is probably a sound basis for JESWIET'S careful analysis, it should, we opine, have been tried over widely different rainfall conditions ; one presumes that all of his specimens were obtained from his collection of canes grown in Java, i.e., more or less at one place. There is something very attractive in a "key" to the difficulties of classification, and JESWIET'S method is eminently such a one. But one believes it is recognized now that such a weapon can only be used after a thorough knowledge obtained by the usual method of many characters, which is increasing in importance in botanical literature. LINNAEUS in dividing plants into classes relied on the number of stamens in the flower, but even he soon found this to be unreliable; this system is now described as "artificial," and it shows a somewhat close resemblance to that expounded by JESWIET. It was in fact a "key," which was however prepared to solve the difficulties of classification before a wide scientific knowledge had been gained of the natural affinities of plants. Later botanists, who included the whole flower, were on much safer ground in that theirs became a "natural" system, giving a definite indication of the relationship of plants in nature. But with the wider knowledge of plants which has been gradually accumulated, many characters, in addition to those of the flower, are being increasingly relied on ; and these cannot be usually made out in herbaria, where only the flowers and fruits with the small branches bearing them are available. This all points to a wide study of all the organs, especially as the flower is ruled out at present in sugar cane varieties, as the true basis of variation of our cultivated varieties.

As at present established, JESWIET'S bud method is, however, bound to find its uses amongst those highly trained people who can make allowance for its fundamental insecurity in not taking note of the peculiarly ecological nature of the basal character, namely, the hairy clothing of plants in general ; but, since the method can only be carried out by such highly trained workers, one is inclined to agree with such critics as Dr. DE CALVINO that it is neither convenient nor practical as a ready means for the *field* distinction of cane varieties.

Sugar Beet Root-lifters.

The Royal Agricultural Society of England has arranged a trial of sugar beet root-lifters to take place about next October in the Kelham district of Notts. There will be two classes as follows :—Class I.—For machines which top and lift the roots and separate them from the leaves and crowns; Class II.—For machines which loosen the roots, leaving them subsequently to be lifted and topped by hand. Entries will be closed on or about May 30th, 1925. The points to which the judges' special attention will be directed are :—Price ; simplicity in design and working; draught; ease of handling; ease in turning; efficiency in lifting or loosening roots ; freedom from damaging roots ; and effective separation of leaves from root.

Further particulars will be available shortly, and may be obtained from the Secretary, Mr. T. B. TURNER, 16, Bedford Square, London, W.C.

The Royal Institute of Scientific Industrial Research of Sweden has awarded its gold medal of the first class to Dr. JOHANNES RUTHS for his Steam Accumulator invention. As was recently pointed out,[1] this apparatus equalises the intermittent load on boilers in factories and power plants, thus securing greater facility in working and establishing substantial economies in running costs. It is claimed that in actual practice fuel economy of 15 to 30 per cent. is obtained when Ruths' accumulator is installed. The invention attracted a good deal of attention at Wembley Exhibition, London.

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[1] *I.S.J.*, 1924, 607.

Fifty Years Ago.

From the "Sugar Cane," January, 1875.

An anonymous writer published some notes on animal charcoal, its manufacture and use, in this issue of our predecessor. Precautions advised in making char were, firstly, that the boiling or steaming of the bones to extract the fat should not be carried so far as to extract gelatine in any considerable amount, otherwise the carbon content would be diminished; and secondly that the bones should be heated for a long time at a low temperature rather than for a shorter time at a higher temperature. Another point was that the ball-and-socket and other soft portions of the bones should be rejected, if char of the best quality was in view, these portions giving a "shelly char, easily friable."

ALFRED FRYER, late Editor of the *Sugar Cane*, controverted some of Russell's statements made when describing his scheme of maceration,[1] his view of the matter being that there was "nothing new in wetting megass with steam and water, and passing it again through a cane mill, and accounts of experiments of this mode of treatment are well-known to all those who are familiar with the literature of the sugar industry, but with such a process the game is not worth the candle. The amount of water added must be large, and the amount of sugar ultimately left in the megass must also be large. The extract must be weak, involving great cost for evaporation . . . . . ."

DRUITT HALPIN and JAMES B. ALLIOTT described their improved type of Wetzel pan, which was capable of taking steam at a higher pressure than the old type of this apparatus, and could be very well used for "dealing with second and third boilings of sugar, the products of which are of an inferior character. In the case of these low-class sugars, the colour is a secondary matter, and as they already have a bad colour which cannot be much injured by a high temperature it is desirable to take advantage of this fact to boil them off quickly by the employment of steam at a higher pressure than can be safely resorted to in the old type of Wetzel pan . . . . . ."

But the most interesting article in this issue was an anonymous one on "Steam Ploughs," giving an account of Fowler's original system. Its principal elements were an engine, an anchor, a wire rope, and a balance plough. "In this system, the engine is placed at the end of one of the headlands of the field to be ploughed, and opposite to it the anchor is fixed. This is a massive framework of wood, mounted on sharp disc-wheels of about two feet in diameter, which cut deep into the ground, and even take such a hold on the slightest soil, as to resist the pull of the wire rope. This is passed round a sheave or drum placed beneath the engine, and by it the plough is driven, the rope being borne off the ground by a number of pulleys, or 'rope-porters,' mounted on frames. The plough is a framework of iron, balanced upon two large wheels, and having four or five plough-bodies and coulters attached at each end, so that so many furrows can be cut at once. When the headland is reached on which the anchor is fixed, the end of the beam that was out of the ground is depressed, the other end being raised by the balance-wheels, and the first set of ploughs come into operation for the return. By altering the position of the plough-bodies along the framework, a broad or narrow furrow can be cut at pleasure . . . . . ."

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[1] *I.S.J.*, 1924, 630.

The United Kingdom Beet Sugar Subsidy.

Debate in Parliament.

The British Sugar Subsidy came up for discussion in Parliament on December 18th when the Financial Resolution authorizing its payment was moved by the Government. The Minister of Agriculture (Mr. EDWARD WOOD) introduced the measure for the Government. His speech, as reported in *Hansard*, was as follows:—

"During something like a dozen years various efforts have been made to establish the beet industry in this country. Those efforts included the abolition of the Excise Duty in 1922, and that was followed this year by the reduction of the Customs Duty, which had the effect of somewhat dislocating the then position in which the industry was carried on. The result was to force the Labour Government to give their attention to the question of what further steps were necessary in order to give this infant industry a chance of establishing itself and of allowing an agricultural experiment to be thoroughly explored. After considerable deliberation they formulated the scheme which is the basis of the present Resolution. We have found ourselves the heirs to their work which, as in this respect we thought it good, we have adopted.

The main proposal is a very simple one. It is to give a subsidy to the industry, and while doing that to reimpose the Excise Duty that had been removed in 1922. At this stage I need not say anything except a passing word as to the general arguments that have led to this policy. They were arguments agricultural, relating to the condition of the development of a new crop, arguments relating to employment, because it is evident that this crop and the general development of the factory production, if it can be developed, will lead to greater employment; and, lastly, an argument that always appeals strongly to myself, namely, that it was a desirable thing, if you could, to stimulate production of home-grown sugar. I think it is also true to say that the experience of all beet-producing countries goes to show that with this industry it is necessary to be prepared to give a measure of assistance in the earlier years. It is not a very easy business to start. For one thing the farmers are naturally very conservative people. It is a badge of their tribe in all countries. They want a certain inducement before they will start out on a new departure. Of course, the general process of manufacture is highly technical, and before it will be undertaken both farmers and the manufacturing side of the industry demand a certain measure of stability.

The principal reason that led the late Government and this Government to substitute the policy of subsidy for the policy of remission of Excise Duty was that, unless you were to tie the hands of the Chancellor of the Exchequer in dealing with the Customs Duty on sugar, it was impossible to give stability to sugar beet production in this country. It is evident that, in so far as they depended for protection on the scale of Customs Duty, as soon as that scale was varied so their measure of protection would automatically be varied and instability would be introduced. I would also emphasize this—that if stability is necessary from the point of view of the industry, in my judgment it is not less necessary from the point of view of the State that the assistance which the State gives should be of a temporary character; that is to say, that the commitments that the State undertakes should be definite and that the State and the taxpayer should know where they are. For that reason it has been proposed that the subsidy shall be payable for 10 years on a decreasing scale, the first four years on a certain scale, gradually falling to extinction at the end of the term.

As a condition of that subsidy it will be necessary for the factory to pay the growers a certain minimum price for the beet which they buy from the farmers during the first four years. That price will be fixed in the Bill at a figure of 44s. a ton, with 15½ per cent. of sugar content. The second condition, which we propose to attach to the enjoyment of the subsidy, is one that will commend itself to all members. That is a condition that a factory enjoying the subsidy should have in its plant a considerable proportion of machinery made in this country. That is reasonable, because we are stimulating this industry by British money, and it is not unreasonable to ask and to secure that the greatest possible benefit inures to British industry out of the public money expended. The percentage that will be suggested in the Bill is 75 per cent. It will be necessary to add certain conditions to that, and they will be found in full in the Bill. I hope, therefore, that these proposals will be found to be largely non-controversial and agreed. I think that the veriest Free Trader need not fear that the late Chancellor of the Exchequer (Mr. SNOWDEN), who was responsible for the initiation of these proposals, would have put his name to anything that could seriously be thought to impugn the principles of which he is so devoted a disciple. Indeed, every Free Trader, from the great economist downwards, would admit that it was not unjustifiable to afford a special measure of help to a nascent industry. There is, however, one aspect of the question that has excited some criticism. That is its reaction upon the business of the great refining industry carried on in this country. The refiners have complained that the scale of the subsidy as at present drawn confers a preference upon the production of refined sugar as compared with the production of what may be called raw sugar, and thereby they fear that the attempt which we are making to assist one British industry will merely be made at the expense of another established industry.

For my part I say at once that any such objection or consideration as that is entitled to the most careful and sympathetic consideration of the Committee. That I will endeavour to give it. I cannot help thinking, however, that that fear is based upon some misappreciation of the facts. Apart from the fact that the whole modern development of this business in Continental countries, as I am advised, favours the establishment of a continuous process in one factory, from the handling of the raw material, the beet, to the final manufacture of the refined sugar, as the most economic process, I think it might be supposed, from the objections that have been stated publicly by those who speak for the refining industry, that it was proposed in this subsidy actually to give a preference to refined sugar over raw sugar. It might even be supposed, from some of the literature I have seen, that no subsidy was being given on the production of raw sugar at all. That really is a great misconception. The scale of the subsidy we propose is exactly the same as the scale at present enforced in the Customs Duty. Therefore, I confess that it is a little bit difficult for me to understand why a scale which is so fair in Customs would necessarily be unfair in the subsidy If at any time a case was established for the variation of the Customs scale, of course the subsidy scale would properly vary with it. I am advised that it would be almost impossible, or at all events administratively most difficult, to try to work on two scales for the two sides of what is really a single subject.

I go a little further than that. I suggest there is only one basis on which you can deal with this question, whether you are dealing with it by Customs or dealing with it from the angle of subsidy. You must deal with it on the basis of the closest scientific approximation you can get to the amount of extractable sugar content at any given stage, and that is the basis upon which we have tried to proceed. We have sought to hold the scales absolutely evenly between the raw sugar interest and the refining interest. From my point of view as Minister of Agriculture, it does not make a great deal of difference—it does make some difference, but not much—whether a factory wants to make raw sugar or refined sugar. There are some people who have sugar factories, and who are putting up factories, who want to make white sugar. There are others who, partly because the process is not so expensive and partly because they have other facilities, wish to stop at the raw sugar process. Our scale is devised in an endeavour to mete out impartial justice according to a scale, the scientific value of which has been more or less accepted.

I would point out that there is nothing in the world to prevent the refining interest, if it wishes to do so—as I greatly hope it will—itself going into this business and establishing its own factories and thereby qualifying itself to draw the subsidy. I go even further. I think it might have been argued that the refining interest had certain grievances if the case had stood at this point, namely, that the subsidy was to be payable on the product of a factory, and if that factory finished raw sugar, it might have been argued that a man who took on raw British sugar and finished it off, up to the refining stage, was suffering an injustice in face of the competition of the other subsidized complete process carried on in another factory next door. Therefore I propose to extend slightly the principle by which, if a refiner prefers to go into the raw sugar process and carries the raw sugar away to his existing refinery, we propose to pay him the sugar subsidy on the refined sugar on the final stage in the refinery. I hope that by this concession we may go a long way towards removing whatever measure of injustice was—as I think wrongly—conceived to lurk in our proposals.

A few words in conclusion as to the cost of the Financial Resolution. It will be recognised that it is difficult to estimate with complete accuracy a cost which, obviously, depends upon the number of factories established and upon the type of those factories. The best estimate I can give is that it will cost £530,000 gross this year by way of subsidy, Off that has to be taken about half, which represents the income from the reimposed excise. which leaves the net cost to the State about £265,000. Those figures will be doubled for the second year, but beyond that it is impossible to make any forecast without knowing how many factories will be built. It may interest the Committee to know that three factories are in operation and eight new factories are contemplated, of which, I think, six are likely to be ready for working by October, 1925, and will be therefore ready to take next year's crop.

Mr. BUXTON (Lab.) who spoke for the late Government expressed pleasure that the present Government proposed to carry on the policy formulated by their predecessors. The only point that gave him doubts was the wisdom of the condition as to 75 per cent. of the machinery being British. He asked the Government to exercise special vigilance to see that the best possible machinery is bought without handicapping or interfering with the factories that are to be established. There was rather a warning experience, he added, in regard to the factory which the Government financed at Kelham; a great deal of the machinery had in the end to be replaced. As regards the agriculture of the sugar beet he considered that the farming community were going to derive from the subsidy a degree of education that would make the expenditure worth while. It necessitated for instance the use of various new forms of agricultural machinery. One could not even get the sugar beet crop up without using a lifter, which was quite unknown in connexion with other crops. Again one cheapened the processes of arable farming generally because of the extraordinary qualities of the beetroot crop, which as contrasted with other root crops was a paying one. In Germany it was said that the wheat crop on a given area has been increased by as much as 15 per cent. But the real example for us was Holland which after a period of protection became a model of free trade in regard to sugar, and the industry there without any help at all was now an extremely flourishing one.

Mr. MACQUISTEN (U.) strongly supported the proposal as to British machinery preponderating in the new factories and did not think it was necessary to get even 25 per cent. of the machinery from abroad. Men who had been walking about the streets of Glasgow looking for work would now be engaged in making sugar machinery. In his view the earlier factories made a mistake in going abroad for their machinery. The manufacture at home of future equipment would be an immense help to the engineering industry. As for the agricultural side of the industry, all history showed that the beet sugar industry never grew in any country without assistance at the start. But our home production would never be able to undertake the supply of more than 25 per cent. of the sugar we needed in this country; it would be an immense help, however, in keeping down the price of sugar.

Mr. HANNON (U.) speaking for the refiners said they were not opposed to the principle of the subsidy generally, but only to its extending to sugar of a higher polarization than 98°. If the beet sugar manufacturer was permitted to manufacture sugar exceeding that quality he was given a measure of protection of 21s. 5d. as against the man now engaged in the refining of sugar in this country. The British sugar refining industry to-day was quite willing to co-operate with the beet sugar factory in converting its raw sugar into white sugar; it would be glad to see raw sugar manufactured up to 98° polarization, but above that point the State was using the taxpayers' money to strike a blow at the refining industry. Sir GODFREY COLLINS (L.) spoke in a similar strain and appealed to the Government to give special consideration to the Greenock sugar refining industry.

The United Kingdom Beet Sugar Subsidy.

The Financial Secretary to the Treasury (Mr. GUINNESS) explained why the Government could not agree to cut the subsidy short at 98° polarization as moved by Mr. HANNON. The Customs authorities claimed that the present scale of duties represented the relative sugar values of each degree of polarization as fairly as could be arrived at. But when the scale was originally laid down the refiners complained that it allowed for the recovery of too high a percentage of sugar when you got near the top. Now they were saying the contrary, and he really thought the Government were striking a balance between the two complaints. The refiners' argument appeared to be that though the scale was fair for Customs and Excise it was not fair as a basis of subsidy. The Government on the contrary believed that the scale did give that fairness and that it offered no preference to the *refiners*[1] as against the raw sugar producers. If the scale was unduly favourable to the *refiners*[1] in declaring sugar at high polarization, it was also perfectly fair to the position of the refineries to give them the opportunity to establish factories and to share in the benefits of the subsidy. If they did not want to do that, they could take over the sugar in an unrefined state and refine it themselves and get a payment for the refined that would put them on absolutely equal terms. He mentioned that the Bury St. Edmunds factory which was being projected by a Czecho-Slovakian group did not intend to produce white sugar, so that their sugar would be available for the refiners As a matter of fact he did not think the refiners really wanted the lower scale. "This is the report of their case as put before the Board of Customs and the Minister for Agriculture. The British sugar refiners ask that the subsidy should be confined to unrefined and withheld from refined sugar. In default of that the subsidy scale should be adjusted to give more subsidy proportionately to unrefined than to refined sugar, so that factories might be encouraged to produce the unrefined article which would have to be sent to the existing refineries for refinement. See what that would mean. It would actually penalize the British producer as against the foreign producer. At present a consumption of 1,500,000 tons exists in this country and there are about 500,000 tons brought in ready refined from abroad. That sugar under this proposal would still come in. The foreign refiner would be allowed the full benefit of our market, but a new and promising sugar industry in this country would not be allowed the same opportunities for economic production but would be prevented by artificial working of the scale against them from engaging in this industry, the product of which in foreign countries is given free entry in this market. That is a policy with which we cannot agree. We feel that in this subsidy we must hold the scales absolutely even and not interfere as between one part of the industry and the other. We do not think it would be fair to give preference to existing refiners and by so doing to penalize the new factories from going into business."

After further debate, the Resolution was put to the House, and carried by 223 to 22 votes.

The following is the scale of subsidy so far as it has been published by the authorities:—

SUGAR.

	If manufactured at any time within		
	The first four years of the period.	The next three years of the period	The last three years of the period.
	s d.	s. d.	s d.
Of a polarization exceeding 98°..	19 6 ..	13 0 ..	6 6
Of a polarization exceeding 76° and not exceeding 77°	9 8·0 ..	6 5·3 ..	3 2·6
Of a polarization exceeding 77° but not exceeding 98°.. ..	Intermediate rates varying between 19 6 .. and 9 8·0 ..	13 0 .. and 6 5·3 ..	6 6 and 3 2·6

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[1] We are not able to follow this argument, save on the assumption that "refiners" (as italicized by us) was meant by Mr. GUINNESS to refer to the white sugar stage at the beet factory.—Ed. *I.S J.*

MOLASSES.

	If manufactured at any time within		
	The first four years of the period	The next three years of the period.	The last three years of the period.
	s. d.	s. d.	s d.
Containing 70 per cent. or more of sweetening matter	12 4·7	8 3·1	4 1·5
Containing less than 70 per cent. and more than 50 per cent. of sweetening matter	8 10·9	5 11·3	2 11·6
Containing not more than 50 per cent. and not less than 45 per cent. of sweetening matter..	4 3·8	2 10·5	1 5·2
Containing less than 45 per cent. of sweetening matter.	Rates bearing the same proportion to the rates specified as aforesaid in the case of molasses containing not more than 50 per cent. and not less than 45 per cent. of sweetening matter as the percentage of sweetening matter bears to 50 per cent.		

The British Beet Sugar Industry.

Progress of the New Factory Schemes.

Details are now published of the new Ipswich factory projected by the Anglo-Dutch group. A limited company entitled The Ipswich Beet Sugar Factory, Ltd., has been formed with a nominal capital of £300,000. The Board of Directors follows much the same personnel as that of the same group's Ely factory described in our November issue.[1] The names comprise: Col. G. L. Courthope, M.C., M.P., Whiligh, Sussex; Sir James Martin, Kt., J.P., 50, Gresham Street, E.C., incorporated accountant; Sir Edward Packard, Kt., J.P., The Grove, Bramford, Ipswich; J. P. Van Rossum, Heerengracht 493, Amsterdam, beet sugar manufacturer; Dr. A. Wijnberg, Heerengracht 567, Amsterdam, beet sugar expert; Dr. J. A. Van Leen, Juliana Van Stolberglaan 115, The Hague, Holland, beet sugar expert. The Secretary is Mr. ALFRED WOOD, F.C.A., and the registered office is 6, Lancaster Place, Strand, London, W.C. 2. This factory will serve sugar beet growers in South Suffolk and Essex; it will manufacture white sugar and dried beet pulp, and will have a capacity of 1200 tons of roots per day. It will be ready for the campaign next October.

The West Midland Sugar Company, Ltd., which was registered last month, is concerned with the Kidderminster scheme. The directors are: Right Hon. Baron Weir, of Eastwood, Eastwood Park, Giffnock, Glasgow, engineer, chairman (chairman of G. and J. Weir, Ltd.); Right Hon. Baron Invernairn of Strathnairn, Flichity, Inverness-shire, shipbuilder (chairman of William Beardmore & Co., Ltd.); Right Hon. Sir John Baird, Bt., P.C., C.M.G., D.S.O., M.P., Ury, Stonehaven, Kincardineshire (director of Anglo-Scottish Beet Sugar Corporation, Ltd.); Sir Ernest Jardine, Bt., The Park, Nottingham (director, Anglo-Scottish Beet Sugar Corporation, Ltd.); J. B. Talbot-Crosbie, Raheen, Bearsden, Glasgow, engineer (managing director, Duncan Stewart & Co., Ltd.); G. R. Woodward,

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[1] *I.S.J.*, 1924, 573.

J.P., The Gables, Kidderminster, carpet manufacturer (director of Brintons, Ltd.); and C. C. Brinton, Yew Tree House, Balbroughton, carpet manufacturer (director of Brintons, Ltd.).

The capital is £250,000 and the directors may borrow an equal sum without special authority. Application has been made for a loan under the Trade Facilities Act. This is a factory of the Anglo-Scottish group, and the equipment is being supplied by Messrs. Duncan Stewart & Co., Ltd., Glasgow.

Messrs. Duncan Stewart & Co., Ltd., are also providing the machinery for the Spalding factory of the same financial group. Each of these two factories will be capable of slicing at least 1000 tons of beetroots per day. The equipment includes the necessary plant for recovering sugar from the molasses. Allowing for working capital, the cost of each factory will come to over half a million sterling. A reasonable output for such factories can be taken as 10,000 tons of sugar a year.

Finally, there is the Bury St. Edmunds factory scheme which is being promoted jointly by English and Hungarian interests. Messrs. Tate & Lyle, Ltd., are the principal British promoters while half the cost of the undertaking (about £350,000) will be subscribed by a group of Hungarian capitalists. The factory is to be on a site of some 45 acres and is being started at once so as to be ready for the 1925 slicing season. It will be capable of producing either raw sugar to send to the refineries or else finished white sugar. The capacity is said to be about 1500 tons of roots per day. A company is being formed to work the factory; included on the board will be Lord DENBIGH, Sir DOUGLAS NEWTON, three directors of Messrs. Tate & Lyle, Ltd., and three members of the Hungarian group, one of whom we understand is Mr. I. J. SCHAPRINGER who has been connected with the preliminary enquiries into the feasibility of the Bury St. Edmunds project.

Dr. PRINSEN GEERLIGS recently compared[1] the chemical control results reported for Cuba (by the Sugar Club of Havana) and Java (by the Experiment Station) for the crop of 1923-24, the following being the average values for the two countries in the order above: sucrose in cane, 13·20 and 13·06, purity of the normal juice, 83·48 and 84·60; purity of the final molasses, 32·80 and 31·30; sucrose recovery, per cent. sucrose in the cane, 84·74 and 83·10; sucrose recovery, per cent. sucrose in the juice, 91·31 and 90·71, and sucrose lost, per cent. sucrose in the cane, 2·01 and 2·14 per cent.

Dr. HARVEY W. WILEY recently celebrated his eightieth birthday, and was presented with a bronze medallion by prominent American chemists as a mark of their esteem. Dr. C A. BROWNE (who now occupies Dr. Wiley's former appointment as Chief of the Bureau of Chemistry, Washington) on the occasion of the presentation said that: "The American people can indeed be thankful that with the alarming increase in the adulteration and debasement of their food supplies, a reformer was found in the person of Dr. WILEY, who, after years of strenuous effort in the face of strong opposition, finally secured the passage of the Food and Drugs Act, one of the finest pieces of constructive legislation ever accomplished and a lasting monument to his work as a public official."

Our valuable contemporary, *Sugar News*, publishes each month extracts from the *Planters' Weekly* (of Hawaii), headed "Forty Years Ago," and in one of these appears the following statements relating to the controversy of diffusion *vs.* milling, which was active at that time: "The cane mill is a failure, whether of three, five or 35 rolls! Its best friends must admit that it does not accomplish what is desired of it, even in the best of hands . . . . . No mill ever has and no mill ever will attain, no matter how favourable the conditions, such results as Prof WILEY has achieved with sorghum, and MINCHIN with tropical cane . . . . What would be thought of an extraction of 96 per cent. of all the contained sugar from our canes by milling? Or of bagasse which should give 'scarcely a chemical trace' of sucrose, even as the result of a short, experimental run?"

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[1] *Indische Mercuur*, 1924, 47, 725-726.

Arrowing of the Cane in Hawaii.

This paper of **Alexander's**[1] is exactly what it professes to be. It is not a general discussion on the flowering of the sugar cane, but a compact statement of observations made in the sugar cane fields of the Hawaiian Islands alone; and these observations are drawn from answers received to a questionnaire issued by the author to the planters, coupled with his own extensive experience in the plantations. Although this questionnaire appears to have elicited very few replies, those that were received contain a number of very apposite remarks and we have a very full idea as to what the general opinion on the subject is in Hawaii. It would have been interesting if the author had attempted to correlate the mass of facts collected in the islands with the results obtained elsewhere, where the subject has been more extensively and scientifically studied, but he has steadily refrained from referring to any outside source of information.

When all is said and done, the flowering of plants is a natural process which marks the final stage of normal growth; and, as this is usually dependent on the changing seasons, it generally occurs in each plant and place at one definite time of the year. As the sugar cane is grown under very varying climatic conditions, the world over, we meet with great variations in the phenomena connected with its flowering. In places where it is grown outside its tropical environment, flowering is often inhibited, as in south Queensland, Natal, Louisiana and north India. And, furthermore, because of its having been for ages propagated by purely vegetative methods, many varieties have lost to a large extent their capacity for producing fertile seed, or indeed of flowering at all; and conseqently the amount of arrowing met with in different kinds of cane varies a great deal. Lastly, owing to the number of seedling canes which have taken their place in the fields during recent years, it would be naturally expected that arrowing in the fields is increasing day by day, for the very good reason that all of these seedlings are the progeny of kinds which have retained their power of producing fertile seed; but no definite data appear to have been collected on the subject.

It must also be remembered that the problem of the control of this habit —generally undesirable because of the cessation of growth in the flowering cane stalk—is a very different thing in those countries where the canes habitually mature in about a year's time, and in those, like Hawaii, where they may be in the ground for anything between twelve and twenty-four months or even more. This accumulated information in **Alexander's** paper, the fullest probably which has yet appeared on the subject in any country where one-year canes are regarded as "immature," and are not considered as ripe for cutting until a second year's growth, is a valuable addition to the literature of the subject; and a résumé of its contents should be of interest to all who are concerned as to the effect of arrowing[2] on the total crop of sugar, or indeed to anyone engaged in the raising of seedling canes.

The author divides his subject matter into these two main sections, according as the cane is "mature" or "immature," or in terms of Hawaiian parlance, from 16 to 20 months old or from 6 to 11 respectively. When the canes are nearly ripe the matter is of no special significance, but this is far from being the case with immature canes, where the crop has to depend to a much greater extent on side shoots ("lalas") following arrowing.

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[1] A Report on Tasseling W. P. **Alexander**. Presented at the Second Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, October, 1923.

[2] The author uses the word "tasseling" throughout; this has been changed to "arrowing" as a term more widely employed.

Arrowing of the Cane in Hawaii.

I.—ARROWING IN THE MATURE CANE.

Cane varieties differ as to the quality and time of flowering, together with the capacity of continuing their growth by means of side shoots. As to the quantity of arrowing a list prepared by **HENKE** for Hawaii is referred to, in which it is stated that Yellow Caledonia and Big Ribbon arrow least of all, Striped Mexican, White and Rose Bamboo, and H 146 most, while D 1135, H 109 and Lahaina occupy an intermediate position. The arrows of D 1135 and H 109 are the first to appear, immediately succeeded by Yellow Caledonia and the Tip canes, while Badila and Uba are very late. Details as to the ease of producing side-shoots are not given in the paper, but Yellow Caledonia, while rarely arrowing, is said to shoot very readily when it does. This together with the fact that it does not die back after arrowing as some canes do, has added to its attractiveness when not irrigated, while when irrigated the same characters have led to its abandonment, because of the increased poverty of the juice.

The author considers that elevation has a decided influence on arrowing (most probably as **AGEE** observes because of the accompanying change in climatic conditions). As far as observations have extended there is little or no arrowing below 50 ft. above sea level, but a steady increase from this to 500 ft., after which a falling off occurs till 1000 ft., beyond which few canes flower.

Investigations by the United States Agricultural Department are quoted as supporting the theory that flowering in crops is brought about by the decreasing amount of sunlight during the day as autumn (north of the equator) continues. The idea is that this change tends to bring to a close the vegetative period in plants and induces them to enter on the final fruiting stage. And, as Hawaii is very near the tropic of Cancer, the changes in the length of day are much more marked than in many tropical sugar cane countries. Leaving aside the question as to whether the cane is typically an annual or a perennial grass, it should be an easy matter to test this by a world wide comparison; also to see whether the succession of dry and wet periods may not have something to do with it as well. Be that as it may, some rather interesting cases are given which would seem to support the light theory. At Kahuku, the first arrows appear in fields which, after September, are shadowed in the afternoon by cliffs to the west. Similarly, in the Manoa sub-station, which lies at the foot of a thousand ft. cliff, flowering commences before it does at Makiki, where presumably this condition is absent. The possibility is also hinted at that local variations in the time of flowering may be influenced by the prevalence of the cloudy days, "kona," which occur during September. Generally, in Hawaii, the first "flags" appear during the last week of October and the first in November, and reach a maximum about the beginning of December; a few late varieties arrow in January but flowering is usually over by February. Opinions appear to differ as to the effect of the reduced temperature at this time of the year.

As to the influence of the moisture and fertility of the soil, the author hesitates to commit himself, as he considers it impossible to gauge it exactly. A series of cases and opinions are, however, presented which he has received from his correspondents. In 1922, irrigation was stopped in a number of fields at Ewa some two months before November 1st, while in the adjoining fields it was steadily continued. A marked difference was noted in the amount of arrowing in these two sections; in the former it was estimated at less than 2 per cent., while in the latter it was much greater, reaching 15 per cent. in different places. In another plantation, after a dry spell of ten months in 1917, practically no arrows appeared, whereas in the next year which was a wet one the canes flowered profusely up to 800 ft. in elevation. Again, "where there is more water the cane arrows freely," "cane growing in wet spots arrowed heavily, while surrounding clumps on high land did not arrow at all"; "any abnormal or subnormal condition checks flowering," "a high profusion of arrows in the autumn may occur as the normal end to an exuberant existence." The author concludes that there is no experimental evidence to show why under very favourable conditions of food and moisture cane will flower, while in adverse circumstances it will not, or *vice versa.* Then follows the somewhat curious sentence "Fertiliser does not *always* work on *big cane* to hinder arrowing," which perhaps gives a clue to the author's doubts on the subject. (See the evidence in the "immature" section.)

The fact that canes at the edge of a field and along the sides of watercourses flower more freely than in the rest of the field is explained differently by different observers in Hawaii, and no definite conclusion is arrived at by the author. He permits himself to make a "guess" that the cause may be a slight checking of growth following a quicker drying out of the soil; he surmizes that the temperature changes are greater on the exposed side of the field, and accepts the suggestion that an increased circulation of air in these places may account for increased arrowing. Lastly he believes that the large amount of water along the watercourses, with the succession of wetting and drying out of the soil, may have its effect. These are interesting suggestions, but it occurs to the present writer that, until experimental evidence is produced, it might be simpler to rest upon the fact that the free development of the canes is better safeguarded in these places and therefore that arrowing is likely to be more certain in due season.

The relative frequency of arrowing in plant cane and in ratoons, and in young and old cane is next considered. As to the former, a very striking case is presented from counts taken at Ewa during 1922 and 1923, all of the fields being systematically "counted" during these years as is seen below. The average percentages were, for plant canes, 4 06 and 5·22 and for ratoons 9·27 and 9·13. Reports from Oahu, however, state that in favourable conditions, the arrowing among plant canes and ratoons is about the same. Another correspondent reports having made counts in 30 fields of plant canes, and in first, second and third ratoons; only slight differences were observed, but the soil varied so much that the figures were regarded as of little value. The age of the cane is considered by the author as being of some influence, but this might easily be masked by other factors, such as elevation. Honokaa reports that 15 months old canes in eight fields averaged 15·25 per cent, ten months old canes 12·25, and five months old showed no arrowing at all (the relation to "maturity" is not understood here).

In judging the effect of arrowing on the mature cane the author justly points out that accurate countings must alone be relied on, as it is impossible by any other method to escape serious error. This has been done for three years on all the fields at Ewa, and a list is given of the relative numbers of fields falling under ten categories, from 0 to 50 per cent., during the years 1922 and 1923. It is seen that marked differences occur in the two years, although the ultimate averages are very near to one another, namely 8 06 and 8·30 respectively. Another count received from a correspondent for his estate gives an average percentage of arrowing of 19 21, the highest for individual fields being 44. The effect of arrowing on the juice of the cane is illustrated by figures obtained from an average of numerous tests with H109 at Ewa, and these are reproduced in the table below.

With regard to these figures the author remarks that cane stalks (of H109) which have recently arrowed have thus a higher sugar content than those that continue to grow; but notes that at Honokaa where similar tests were carried out with D 1135 there was little difference, and that this was in favour of the non-arrowed canes. When the H 109 canes were analysed several months after arrowing and grown on under unirrigated conditions the reverse seems to be true. This is to be explained by what takes place in the further growth of an arrowed cane; it either produces side shoots below the inflorescence or suckers from the stool, or ceases growing altogether and eventually dies back. The juice in the shoots and suckers is poorer, and any such growth draws upon the accumulated sugar in the main stalk. Therefore, unless the cane is harvested within several months after arrowing, this action of the plant is not beneficial, and he shows that this is especially the case in dry regions.

	SHORTLY AFTER ARROWING (No shooting yet)				AFTER THREE MONTHS (Unirrigated condition)				AFTER SIX MONTHS (Unirrigated condition).			
	Brix	Pol	Purity	Q R	Brix	Pol	Purity	Q R	Brix	Pol	Purity.	Q.R
Arrowed cane ..	18·24	16·61	91·06	7·88	18·26	16·62	91·02	7·87	17·44	15·61	89·51	8·48
No arrows	17·72	15·58	87·92	8·60	18·43	16·92	91·81	7·69	17·56	15·96	90·89	8·21

II.—ARROWING IN IMMATURE CANES.

Quite a number of independent questions are involved here. Flowering of half-grown canes is the bugbear of many planters, and to prevent it, cutting back in July has been adopted to a considerable extent. The points to be considered are:—The conditions of arrowing (whether in plant canes or ratoons), its percentage, the capacity of the variety for shooting, the effect of irrigation and nitrogen manuring, the necessity of cutting back and of late planting. Varietal differences, elevation, and local environment appear to have the same influence as in mature canes, but the age of the crop occupies a more important position.

Ratoons cut in January will flower in November, unless in the lowest or highest fields or in such varieties as Yellow Caledonia and Badila. So also, but to a less extent, if cut in February or March. April-cut cane will or will not flower according to conditions, but if cut in May they will probably not, and June cutting is almost safe although there are exceptions. Similarly with planting; if this is done after May there is no fear. As to earlier planting opinions differ. At Ewa H 109 will not produce many flowers, even if planted in February, although this depends to a certain extent on the season and other conditions.

Most varieties planted below 1000 ft. will shoot, unless in extra cold or damp situations. Manure in the form of quickly available nitrogen has a decided effect in reducing and often preventing flowering, if applied at the right time and with sufficient irrigation. This has been demonstrated at Ewa both on a field scale and in experimental cultivation. Canes irrigated regularly (at intervals not more than 20 days), from August through November, stand a better chance of not arrowing. Any check in growth, whether from insufficient food or water, will be liable to hurry the plant into the flowering stage. And, as the shorter days and colder weather pull in the same direction, care must be taken to make the environment as favourable as possible to vegetative growth.

The problem of cutting back must be decided by each manager for himself for all canes (whether plants or ratoons) starting growth before June 15th, and each planter should draw on his experience and not simply follow precedent, so as to make his crop as safe as possible. The matter has been decided as follows at Ewa:—All canes cut for ratooning before March 31st will be "short ratoons," and although flowering is not wanted it will not do much harm. Fields harvested in April and May are specially treated to minimize the danger of flowering in November. This policy is based on experience with H 109 in the field and a set of five experiments conducted on the estate under different conditions. By not cutting back labour is saved in two directions; that employed in this operation is eliminated and hoeing is reduced because the canes close in quicker. At Kilauea in 1920 it was found that a field, with 48 per cent. of arrowing after the first season, went on growing so that the arrowed cane with its shoots weighed more at harvest than the 52 per cent. of non-arrowed cane. And it was calculated that the former produced 4 tons of cane per acre and 0·35 tons of sugar more than the latter. This goes to show that, if a cane will shoot, a small amount of flowering need not endanger the ultimate yield, a further argument against cutting back. The opinions of various correspondents are given in the same vein; and it is evident from current reports that the practice is declining. For instance, one large concern cut back 4600 acres in 1916, while in 1922 they only did so on 600 acres. The author concludes by pointing out to the meeting, at which he read the paper, that the arrowing season was approaching, and urged the planters present to make careful observations so as to produce fresh data for use at the next annual meeting.

C. A. B.

Sugar Cane Cultivation in Mauritius.

The island of Mauritius was discovered by the Portuguese in their journeys to the east, but apparently not colonized; it was afterwards occupied by the Dutch, French and British successively. Lying, however, far away from headquarters, little advantage was taken of its great fertility by each in turn; its chief use appears to have been as a port of call in the days of sailing ships on the long journey to the great eastern possessions of these countries. The Dutch are stated to have introduced the sugar cane from Java in 1650; but their period of occupation, from the end of the sixteenth century to the beginning of the eighteenth, has been described as most disastrous to the natural resources of the country. The sugar cane failed to establish itself and the island was abandoned. The French colonizing it soon after, developed the island to a considerable extent; but, with certain brilliant exceptions, it suffered a great deal at their hands, for the reason above stated. Perhaps the most important of the exceptions was when Mahé de Labourdonnais became Governor; and among other salutary measures he re-introduced the sugar cane in 1747, and the industry was established by the erection of the first factory in 1756. But long periods of exploitation and misrule followed, and when the British obtained final possession in 1814 only 4000 tons of sugar were produced annually. About 1825, however, a great development took place, and sugar being admitted into Britain on the same terms as that from the West Indies, production increased rapidly until, in 1855 it reached the respectable figure of 120,000 tons. Then for forty years little change was noticeable, after which another forward move was made, and about twenty years ago the present level of well over 200,000 tons per annum was reached. An interesting comment on this historical résumé is furnished by the numbers of sugar factories existing at different periods of progress; thus in 1827 there were 162, and in 1855 227; from this point, there was a continuous fall in the number of factories while the tonnage of sugar increased, as follows: 171 in 1875, 104 in 1892, and 66 in 1908, the present figure being about 50.[1]

The writer has found it somewhat difficult to obtain reliable information regarding the cultivation practised in the island; but a recent paper by H. A. TEMPANY,[2] the Director of Agriculture, contains a good deal that is of value in this respect, and much of what follows is summarized from this source. The total area of the island is given as about 460,000 acres, of which 47·7 per cent. is under cultivation; sugar cane is the crop most widely grown and accounts for most of this. The area under cane was 133,000 acres in 1909, but in 1922 it had increased to 174,000, a change ascribed to favourable markets and a great extension of land under Indian as opposed to plantation cultivation. In 1921 Indians occupied 82,000 acres, or 46·6 per cent. of the whole area under cane. The average yield on European estates is given as 23 to 24 tons of cane per acre, although in first year crops 40 to 50 tons are not at all uncommon; but, taking in the Indian farms as well, the average for the whole island is only 17·5 tons.

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[1] H. C. PRINSEN GEERLIGS, "*The World's Cane Sugar Industry*" "*The Mauritius Almanack*" of 1923.
[2] Mauritius and its Sugar Industry. *Louisiana Planter* Reference Book, July, 1924.

The soil of Mauritius is volcanic in origin, and consists of a series of heavy loams. On the whole these are very fertile, although the average depth of cultivated soil is only some ten inches. The high degree of fertility maintained is explained by the careful cultivation and systematic heavy manuring on practically all of the estates. The results of volcanic activity as affecting soil are seen in three directions, namely, in great flows of lava covering the ground often to a great depth, in masses of ashes blown into the air and settling on the ground, and in blocks of lava and rock material in the form of boulders and stones also ejected and falling nearer to the vent. As contrasted with other volcanic soils in the tropics, Mauritius seems to have received more of the latter than is the case in most other countries, for TEMPANY mentions the stony character of the soil as characteristic. The handling of these stones and boulders has naturally greatly influenced the local agricultural practice; and on most estates it is usual to take the trouble to collect them into lines across the fields, the distances apart depending on the numbers of stones present. Long ratooning being also characteristic, it is generally the custom to rearrange the lines of stones before each fresh planting, thus bringing unworked soil into cultivation. This important factor has undoubtedly been of great influence in the development of implemental cultivation; and, thanks also to an abundant supply of labour, this development has not taken place to such a great extent as in most other sugar cane countries.

There being no indigenous tribes in Mauritius, slaves had to be imported, presumably from the neighbouring African shores, for the working of the cane fields. In 1767, out of a population of about 19,000, 15,000 were slaves. But, shortly after the British occupation, slavery was abolished (in 1835); and, the freed blacks being unwilling to continue cultivating the fields, Indian immigration was resorted to. The total present population is given as 370,000, and of this 260,000 are of Indian origin; there are 5000 Chinese, and the remainder consists of Europeans, Africans and mixtures of various kinds and degree. Since the recent stoppage (in 1910) of this Indian influx, labour troubles have commenced, and a reconsideration of implemental cultivation has become rather pressing. But the large numbers of stones have made this difficult, in that the ploughs and cultivators have to be of specially strong make, and this matter is still under investigation. Meantime implemental cultivation is said to be on the increase, although much experience has still to be gained before the special designs required are standardized. As regards transport a considerable change has also taken place. Previous to 1902 this was almost entirely done by cattle, but these were destroyed by a severe outbreak of *surra* at that date, and we are told that the planters had immediately to lay down a system of trams, with the help of Government; and considerable assistance was also rendered by Government railways. At the present time there are hundreds of miles of trams laid down with full equipment of engines and trucks, but unfortunately these tram lines appear to be of different gauges. A change from cattle to any other draught animal would have been useless, for this disease, imported with Indian cattle, appears to be capable of attacking buffaloes, horses and mules, as well as many other animals. It is transmitted from animal to animal by biting flies.

The cultivation in Mauritius varies with elevation, with its attendant differences in climate, especially rainfall. The range of elevation in the fields is from near sea level to 1800 feet, and the rainfall from 30 inches in parts of the lowland, through all stages to as much as 150 in places on the plateau. These differences have an important bearing on the time of planting the cane; thus, in places where the rainfall is very meagre, a period of five months of comparative drought may occur; and the canes must be planted at such a time that they are well established before the dry period sets in. Three main planting seasons are distinguished, namely, (1) *Grande saison*, in August and September, in which case the plants are in the ground for 18 to 20 months; (2) *Petite saison*, in June and July, the growing period being 14 months; and (3) *Demie saison*, in March to June, the growing period being 16 to 18 months.

Planting is done in holes arranged in rows four feet apart. Each hole is 2 feet long and 8 inches deep, and is separated from the next by a bar of earth 1 foot across; the plants are thus 3 by 4 and there are 3200 to the acre. The holing is mostly done by hand, but this preparation of the land for planting is being more and more done by draught implements, the furrows being made by double mould board ploughs. Flat planting is invariably practised, and the cane seed is carefully selected; plant canes are frequently used for the purpose, the cane tops being preferred. After planting, three to four weedings, mostly still by hand, are usual during the season; but this weeding is sometimes performed by cultivators, while the cultivation between the rows is done by subsoiling ploughs. Recently, in cases where the land is moderately free from stones, the land has been first broken up by ploughs, but two to three furrow disc ploughs have been found to give better results; then the furrows are opened by the double mould plough as before. Where tractors are used those of the Cletrac caterpillar type, both large and small, are the favourites. But it appears that all of these methods are as yet capable of considerable adjustment, and the author does not go out of his way to make definite recommendations. It will be interesting to see if the re-opening of labour immigration from India, now satisfactorily arranged, will have any effect on these matters. For hand cultivation the ordinary broad bladed hoe appears to be the favourite implement.

As already stated, long ratooning appears to be the rule (up to six crops); simple cultivation is afforded by breaking up the soil between the rows and moulding up the stools. Trash is sometimes burnt off, but is more frequently ranged in rows and allowed to lie, or buried in the interlines, when it is referred to as *enfouissement*.

The excellence of the manuring system has already been referred to, and this turns out to be comparatively simple in principle. Besides the use of trash, the factory residues are invariably returned to the soil, scums, ashes, surplus bagasse and molasses. The latter is especially interesting, and its use has become standardized because of the proved increase in the yields; it is usually applied to the ground some time before planting. All organic manures are in fact applied only to the plant canes, the chief of them being cattle manure at the rate of 20 to 30 tons per acre. This would imply that the island has recovered from the attack of *surra* some 20 years ago; but of course, with long ratooning and the use of pen manure for plant canes only, it will be less difficult to find the necessary amount of this valuable substance than in the West Indies, for instance, where such long ratooning cannot be employed. And here a digression may be made to refer to a method which appears to be peculiar to Mauritius of preparing an excellent "pen manure," described by HARDY[1] in a recent short paper. By this means, as long as a modicum of urine is obtainable the output of pen manure on sugar cane estates may be largely increased. "Briefly, the practice consists in spreading cut cane trash, herbage or bush to a depth of 2 ft. on the floor of a covered pen. Cattle are turned into the pen daily for a fortnight, when the urine-soaked litter is transferred to a pit whose floor and sides are composed of concrete or stone." With proper precautions this material quickly breaks down to a manure with much greater amounts of nitrogen than can be accounted for by the relatively small amount of urine added. It does not seem likely that this method is much used in Mauritius to-day, as TEMPANY does not refer to it in his article, and HARDY speaks of it as a practice "advocated many years ago by certain planters in Mauritius." Be that as it may, the recent discovery at Rothamsted that good pen manure may be made without the intervention of cattle at all, by using straw, water and finely ground limestone, appears likely to be of considerable importance to the sugar industry in the tropics.

Artificial manures are applied both to plant canes and ratoons. Although the formulae differ, ammonium sulphate is the chief constituent, with frequent addition of potash and phosphate, the latter as guano phosphate and super, and the former as kainit and potassium sulphate, but also as sodium sulphate to some extent. Where the land is exhausted, it is customary in some districts to rest it under leguminous crops (termed *assolement*), the chief forms being *Phaseolus lunatus*, *Mucuna utilis*, *Tephrosia candida* and *Vigna Catiang*, well-known green manuring crops used in other countries.

The question of varieties is simplified by the fact that, although no country has in the past made more determined trials of different kinds of cane, two-thirds of the total area is at present occupied by White Tanna, a variety introduced about 1900. The other canes mentioned are D 74, and three local seedlings, 55 P, 131 P, and 35 P. A number of other varieties are now coming forward as the result of experimental work, but are not as yet of commercial importance. Uba is grown to a certain extent on poor lands.

Cane farming, as has been seen, is present on a large scale; and the rates of payment, usually ranging from 65 to 70 kg. of sugar per ton, is claimed to be more favourable to the growers than in many other countries. Irrigation has had considerable attention paid to it in late years, although never likely to be a very important factor in the island. Two schemes prepared by an expert from India have been taken up, one dealing with 3200 acres and the other with 10,000. An experiment station has been opened to study irrigation problems under the local conditions.

Of pests and diseases, the only serious one at present appears to be a beetle, *Phytalus Smithi*, thought to be introduced from the West Indies about the beginning of the century. Energetic action on the part of the Government and the planters appears to have led to its control, but a considerable outlay is incurred each year for this purpose, the funds being subscribed by the planters. The work is carried out each year with the help of the Agricultural Department; and it is considered that there is a reasonable hope that in time a successful issue will be reached. A number of minor pests of the usual character are mentioned, together with red rot, gumming, smut, and root disease; but none of these is anything like so destructive as the Phytalus.

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[1] Mauritius Pen Manure. F. HARDY. *Tropical Agriculture*, Vol. 1, No. 8, August, 1924.

The industry is well organized. Unofficial representation of agricultural interests in the island exists in a Chamber of Agriculture, which cares for the interests of the planters. A Government Agricultural Department deals with all administrative matters connected with agriculture, conducts experimental work and trains students. In this it is assisted by a College of Agriculture, the upkeep and maintenance, including the payment of the staff, being borne by the planters by special taxation. Co-operative Credit Societies work in close connexion with the Agricultural Department, their chief duty being to supply funds for the smaller Indian cultivators. A Board of Agriculture assists and advises the Agricultural Department.

C. A. B.

The Jeswiet Method for the Identification of Sugar Cane Varieties.

By Dr. EVA MAMELI de CALVINO,
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Description of the Jeswiet method.—In 1916 Dr. J. JESWIET, of Java, published[1] a paper describing a new method for the identification of sugar cane varieties, based upon the distribution of the hairs found on the outside surface of the buds, the sheaths and leaf blades. The observations upon which this method is based are the following:—

(1) The distribution of the hairs on the bud scales and leaf is never the same in different varieties of cane.

(2) The distribution of the groups of these hairs is constant in each variety.

(3) This distribution can be used as a character for the description of the various types derived from *Saccharum officinarum* as well as of other species of the genus Saccharum.

(4) The following characters are very variable and of little importance in the description of cane varieties: Length and diameter of the cane, colour, wax rings, form, length and position of internodes, type of furrow and form of the buds.

Using these observations as a starting point, Dr. JESWIET studies in detail the distribution of the groups of hairs on the bud, sheath and leaf blade of the cane varieties cultivated in Java and classifies more than sixty groups, exactly localizing each group in a distinct zone to which he gives a number.

According to Dr. JESWIET each variety possesses some and lacks some other group or groups so constantly that this distribution can be used also in the search of the genetic relationships of a variety of unknown derivation.

This criterion has been accepted and adopted during the recent International Congress of Sugar Experts in Honolulu, T. H., in July and August, 1924, as the most practicable one. During that meeting it was also stated that in Java a sampling of each seedling distributed, including all the buds of a culm, is taken and preserved in formalin, so as to facilitate any future comparisons.

Criticism.—Due to the fact that the Jeswiet method is based upon a single arbitrary character, it constitutes a method of artificial classification and a return to the old methods of botanical classification, the concept of which has been shown to be erroneous and artificial, as is also indicated by the definition itself. LINNAEUS himself, founder of one of the many artificial systems (based upon the relation of the sexual organs) felt the necessity of a natural system, which would take in consideration all the characters of the plants which are thrown together in a single group.

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[1] J. JESWIET. Description of Sugar Cane Varieties. Part I. Morphology of Sugar Cane. (*Archief v. d. Suikerind.*, XXIV, part I. 1916, Java.)

The natural system is the one used to-day in botanical classification and a system such as the one proposed by JESWIET could only be accepted as a means to a practical end; the grouping of canes in such a way that it be *easy* to find or classify one or the other variety. In fact it may be said that the "sexual system" of LINNAEUS, established by him in 1735, gained great importance owing to the practical end it strove to emphasize, even though it is to-day completely abandoned.

I may be allowed to show that the Jeswiet method fails to possess even this practical advantage. In fact, the presence of greater or lesser numbers of hairs is an ecological character, dependent upon environmental conditions, since many plants which bear abundant hairs in a dry environment fail to form them, or only form them to a limited extent, in a humid environment. The hairy coverings are xerophytic characters and have the function of limiting transpiration. Their importance is, therefore, not only morphological but also physiological.

The same may be stated with regard to the wax layer on the stalks and leaves of cane, since this also is a xerophytic character, tending to limit excessive transpiration. In spite of this, JESWIET, even though attributing great importance to the presence of hairs, denies any importance to the wax layer in the classification of cane varieties.

In the special case of sugar cane it may be stated that the presence of given groups of hairs is not constant, either because they behave as xerophytic characters or, as will be demonstrated in the following paragraphs, because they may be obliterated by other causes. With the object of determining the variability of the character "hair distribution", I examined, by means of a lens, the buds and leaves of numerous canes of the *Cristalina* variety, from the same "Colonia" (Colonia La Conchita), including canes growing on a dry loam and canes growing on a very moist soil. Many other canes, obtained from the experimental fields of the School, were also examined. My observations may be summarized as follows:—

(1) The hairs of the neck and edge of the leaves growing on the dry soil are much more blunt, short and delicate than those on canes from the moist soil which are instead sharper, longer and more bristly. As may be seen, then, if we compare the triangular zones of the leaf with the care which the Jeswiet method requires, they are found to assume two very distinct aspects; one silky and the other bristly.

(2) The groups of hairs arising from the edge of the leaf, above the triangular zone, extend far higher along the leaf blade in the plants from a dry environment than in those from a moist environment. In the former they occupy eight centimetres of the blade whereas they only occupy two to three centimetres of the blade in the latter case.

(3) The presence of basal and lateral hairs on the bud scales is somewhat constant, whereas the hairs of the scale-wing apex are often wanting, due either to the fact that they have been destroyed by ants, mealy bugs or other insects, or because they have been rubbed away by the leaf sheath, a thing easily possible when we consider the size of these particular hairs. Other causes may be active in their removal, as is shown by the fact that, of the many hundred buds examined by me, only one per cent. had the complete quota of hairs in place. The practical value of an application of the Jeswiet method is thereby notably diminished since whole groups of hairs are completely absent so often, that the determination of an

unknown variety would be impossible. Doubtless the old method of studying all the morphological characters of the stalks and buds, would lead to a far more prompt and accurate identification of a cane variety than the Jeswiet system.

(4) It was impossible for me to find the group of hairs, which JESWIET designates as group No. 28, located "frequently" in the small cavity above the point of germination in Cristalina cane, even though I examined many hundred buds of this variety. This zone was glabrous in all the young as well as old buds which I observed. Considering that group No. 28 is typical of this variety, according to JESWIET, we must conclude that the systematic value of this "typical" character is, at best, doubtful.

(5) Another group of hairs which is often lacking, is that numbered 10 in the Jeswiet system and located posteriorly, at the apex of the bud. It is, according to this author, composed of long and tough hairs. Their absence is often due to the fact that they have been destroyed by ants or mealy bugs, and sometimes to the fact that they have never been formed. This is shown by the absence of all traces on the posterior face of the scales. It may be well to mention here that group No. 10 is, according to JESWIET, one of the "constant" group on the buds of Cristalina cane.

(6) The detailed description of the various groups of hairs of the buds of Cristalina cane, may be found in a paper by JESWIET published in 1920.[1] In this paper the author considers Cristalina cane as a bud mutation of the Malay variety "Bandjermasin".

However this same author disregards the value he has given to this description when he states that: "the groups No. 3, 5, 11, 13, 14, 15, 18, 29 and 30 may be either present or absent, whereas the other groups are constant. Groups No. 13, 14 and 28 are especially typical of the variety "Bandjermasin." It is evident that the groups which may be lacking are quite large (9 of the 20 which the author finds in the buds of Cristalina cane) and that, of the three groups considered as typical by the author, two (Nos. 13 and 14) may be either present or absent. The question may then be asked. What is the constancy of these characters ?

I may be allowed to add, here, that JESWIET uses with great frequency the following expressions when describing the various groups: "the given zone is *often* covered with hairs"; or, "this group *may*," or, "*may not* be found in the zone"; or again, "the extremity of the wing is *ordinarily* furnished with hairs" . . . . . and so on. These expressions undoubtedly leave a rather wide margin, and a possibility of identifying more than one variety by one description.

The Jeswiet method was first described, as has been stated, in 1916. Its application has so far been limited to the work of this author and a paper from Hawaii by TWIGG SMITH.[2] In the classical book of Deerr[3] (edition of 1921). among others, may be found a citation of the work of JESWIET; however his method is not applied in the description of the numerous varieties which are later classified according to the old system.

As a conclusion it may be stated that the Jeswiet method for the identification of cane varieties, based, as it is on the presence of special groups of hairs on the leaf or bud, is neither convenient nor practical since these characters are dependent, in quality as well as quantity, upon many external conditions: conditions which the same author invokes incidentally in the description of the varieties which he discusses.

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[1] J. JESWIET—Beschrijving der soorten van het suikerriet.—(Description of Sugar Cane Varieties.)—*Archief v.d. Suikerind.*, Serie 1920, No. 9.

[2] TWIGG SMITH.—The Jeswiet Identification Characters of Sugar Cane.—(*The Hawaiian Planters' Record*, Vol. XXVII, No. 4, October, 1923.)

[3] DEERR, N.—"Cane Sugar," London, 1921, 44-48

It may be added here also, that the hairy zones, which Jeswiet establishes in the bud and leaf, are so small that their identification can only be carried out by persons accustomed to this type of examination. As an example may be mentioned the surface of the bud of Cristalina cane, which is subdivided in 20, and the bud of Kerah cane in 23 zones

Even admitting that the method was established, not for the use of the practical man, but for use by the technically trained, the disadvantages of the inconstancy of the characters, upon which it is based, remain to render it of doubtful value. At best it could only be considered as an auxiliary method for the identification of varieties, to be used by technically trained persons only.

Greater importance and constancy may be found in the characters of the epidermis, as was shown by myself and later by Miyake and Tackeuchi. In 1921 I published a paper[1] demonstrating that the epidermis of the internodes, nodes and leaves of the various varieties is different and distinct. In 1922 Miyake and Tackeuchi,[2] in a paper illustrated with eight plates, gave information relative to the differences presented by the anatomical characters of the upper and lower surfaces of the leaves of various varieties.

These two methods are undoubtedly more valuable, as auxiliary methods, than the one of Jeswiet.

In spite of all this, I am inclined to assert that it is far better to base our identifications upon the greatest possible number of characters, such as those of exterior form, just as has been done in the past.

The most important characters for the identification of cane varieties are, as is well known: the form, size and colour of internodes, presence or absence of the furrow above the bud, the form and size of the bud, its hairiness, the form and size of the ligule, the presence or absence of hairs in the sheath and auricula.

I may add here that various authors consider the colour of cane as an important character whereas others, including Jeswiet, deny any importance to it on the basis of its variability.

It is true that the colour of a cane may vary from internode to internode on the same cane; however, it may be stated that the general coloration of the stalk, as a whole is quite constant in the same variety. I am inclined to believe that colour, even though not a fundamental character for the distinction of varieties, is sufficiently distinct to be taken in consideration and observed in mature, but not too old, canes; this precaution is necessary since the thallus acquires its characteristic colour only with age In fact, if we examine a dozen adult canes of a given variety, we are enabled to state without a doubt what is the characteristic colour of their variety.

In addition, when considering varieties of close parentage, colour seems to be the only distinctive character. This may be seen in the case of the Rayada cane, which is identical with the Cristalina in all characters, except colour. In this case the Jeswiet method is useless, as it shows no differences in the distribution of the characteristic pubescent zones of the two varieties. Besides, Jeswiet himself was obliged to lay stress upon colour as a necessary character in the identification of varieties.

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[1] E. Mameli de Calvino. Estudios anatómicos y fisiológicos de la caña de azúcar en Cuba. Bol. No. 46 de la Estación Experimental Agronómica, Cuba, 1921.

[2] T. Miyake e Y Tackeuchi. Morphological Anatomy of the Leafblade of Sugar Cane. (Report of Depart. of Agric. Govern. Research Instit., Formosa, N. 1., August, 1922).

Present Needs in Cane Disease Control.

A Rejoinder to Mr. A. H. Lee.

By W. E. CROSS, Ph.D.

I am inclined to believe that the most important "present need" in cane disease control is that the writers of general articles on the subject should be well acquainted with the facts, and that they should confine themseves strictly to these facts and to well deliberated conclusions based upon them. This belief which I have had for some time is confirmed by the remarkable statements found in an article signed "H. Atherton Lee, pathologist," in the October number of the *International Sugar Journal*,[1] in which the introduction and propagation of the mosaic disease throughout the new world is explained in a facile (but erroneous) manner, the author permitting himself to lay the blame on certain Government experiment stations, and on some "rather well-known cane men." The author pretends that it would have been easy to prevent the spread of this and other diseases if the sending and receiving of the cane shipped from one country to another had been in the hands of "competent cane men," working in contact with "men versed in cane diseases," importing only "carefully selected cuttings," etc.

It is very surprising that a pathologist should write in this way, indicating what ought to have been done, and distributing the blame among other people, when the very people responsible for all this trouble and loss are the pathologists themselves, who worked in the Oriental countries where these diseases originated. For in many cases the distribution of the diseases in question took place because the pathologists of the countries where the canes originated had not yet recognized the importance of the diseases, or did not even know that they were diseases at all. Thus the "cane men," including the specialists, in the countries receiving the cane were not on the look-out for these diseases because they were either not yet described by the pathologists in the countries where they abounded, or no importance was attributed to them by these same specialists.

Thus Mr. ATHERTON LEE states now: "Downy mildew of sugar cane is a disease carelessly introduced into Formosa." But Mr. WILLIAM H. WESTON, jr., says: "Although this disease occurred and was recognized as a disease in Queensland, Australia, and in the Fiji Islands and in Formosa as early as 1909, no published reference to it was made until June, 1911."[2] How carelessness can be ascribed to the people in Formosa in importing canes infested with a disease not described in the literature, is not easy to see. The blame for the damage done in Formosa is due to the pathologists of Australia and Fiji, who as far as I am able to find out, up to 1921 had not published any description of, or warning against, this disease,[3] thereby allowing it to be imported into the Philippines, where it constituted "a grave menace to the sugar industry of the islands."

Take again the Fiji disease, which Mr. LEE says "is a comparatively new trouble in the Philippine islands," and "is another good instance of how precautions to secure exclusion would have saved some of the growers considerable worry and added to their cane yields year after year." Known in the Fiji Islands, Australia, and New Guinea since the year 1910, "in 1916 it was found in the Philippine Islands, and there is considerable circumstantial evidence to indicate that it was introduced there on cane cuttings imported from Australia about the year 1912." But how could the people of the Philippines, even "men versed in cane diseases," be on their guard against this disease when, however well known it was in the countries mentioned in 1910, it had not yet been reported in any form in the literature, not only up to 1912, but for many years later? According to Dr. H. L. Lyon[1] it was only "late in 1920" that "the plant pathologists of the Philippine Islands discovered Fiji disease" in their cane fields. "Mr. H. A. Lee has recently sent us," he says, "carefully fixed material for cytological study, and in this we find the pathological tissue characteristic of the Fiji disease."

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[1] *I.S.J.*, 1924, 543. [2] *Phytopathology*, Vol. 11, page 371 (1921). [3] *Loc cit.* page 375.

The same thing applies, but in a more aggravated way, to the mosaic disease. This disease spread from country to country long before it was described by the pathologists as a serious pest; in fact, before most of the pathologists of the countries of origin had written a word about it, or taken any notice of it whatever. *Years after* the distribution of the disease they got acquainted with it and began apportioning the blame for its distribution.

Mr. Lee says that the mosaic disease was introduced into the Argentine with the Java canes, and that from there it was introduced for the first time into Porto Rico by the same canes. This is entirely wrong, as I shall proceed to demonstrate later, but let us suppose it to be true for the moment. The Java canes were introduced into the Argentine in 1908. At that time, as we have been informed comparatively recently by Dr. Lyon (*loc. cit.*), the mosaic had already been noted in Hawaii without anything being said about it in the literature, however, either then, or for many years afterwards. Dr. Lyon carried on an intensive investigation of this disease in Hawaii between 1910 and 1914, but in this latter year, when the studies were discontinued, "the work had not reached such a stage of completion as to warrant its publication." It is evident however that another reason for not publishing at that time was the comparatively slight importance attributed by Dr. Lyon to the pest. This is shown clearly by the following statement of J. A. Stevenson,[2] "Lyon, of the Hawaiian Sugar Planters' Station, in commenting on the writer's paper . . . . first directed attention to this possibility [of the identity of the mottling disease of Porto Rico with the Yellow Stripe of Hawaii and Java]. In fact he went further, insisting they were identical, and *insinuating that the mottling was neither 'new to Porto Rico,' nor 'alarming'* as stated in the article in question."[3] When Lyon finally published in 1921 he stated: "The appearance and spread of mosaic disease in the southern United States and throughout the West Indies, and the invasion of the Philippine Islands by Fiji disease, have brought these two diseases into prominence and created the desirability of clearly differentiating them from the all-including Sereh of Java. The following discussion is offered at this time in the hope that it may help to accomplish this purpose, and otherwise be of assistance to those now conducting critical studies of these diseases."

As Mr. Lee says with regard to the eastern countries in general, "there is considerable circumstantial evidence to indicate that mosaic disease has been well-established in Oriental countries for many years," yet the pathologists of these Oriental countries (outside of Java) only woke up to the fact (as far as the literature goes at any rate) four or five years ago. Mr. Lee only found it in the Philippines in October, 1920,[4] but cites Dr. Lyon to show that it was already there before 1910, although nothing was published about its presence there at that time. So little importance was given to the matter that when Dr. Lyon sent his first announcement about it to *Science* in 1917, this journal did not see fit to publish it, and Dr. Lyon contented himself with sending type-written copies round among plant pathologists in Washington, Cuba and Porto Rico.[1] The nature of this communication, which was a summary of the then known facts about the mosaic disease, indicates that he considered that it was unfamiliar to the "men versed in cane diseases" at that time (1917). And yet Mr. Lee blames the Argentine for not recognizing the pest when they imported the Java canes in 1908, and when they sent the disease to Porto Rico (as he claims), which would have to have been sometime before 1914.

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[1] Bulletin Experiment Station Hawaiian Sugar Planters' Association, Botanical Series, Vol. III, part 1, (1921)

[2] *Journal of the Department of Agriculture of Porto Rico*, Vol III, No, 3, p. 53, (1919)

[3] Unpublished note cited by Stevenson.

[4] *Philippine Journal of Science*, Vol. 14, p. 418, (1921).

In his note Dr. Lyon says that there already existed at that time considerable literature about this disease, but in spite of its "having been well established in Oriental countries for many years" as Mr. Lee says, none other than Java literature could be given: no warning had been given to the world about this pest from Hawaii or the Philippines. And the trouble is that even the Javan experts issued no real warning. Kruger, who wrote a kind of general handbook for the cultivation of cane in Java,[2] devoted 166 pages to his chapter on "the enemies and diseases of the cane," giving first of all a short synthetic review of these (27 pages), and then a detailed description (139 pages) of the "most important pests and diseases." The mosaic or yellow stripe is mentioned only in the first part, and is dismissed in eleven lines of small type. He says that the yellow stripes which constitute the characteristic symptom of the disease can be made to disappear by the application of nitrogenous fertilizers. The pest was thus not thought to be a serious matter, which explains the casual nature of the notice given to it.

A Java reference not mentioned by Dr. Lyon is the important work of Kobus[3], who displayed a very thorough knowledge of the disease and its effects upon different varieties of cane, he having had perhaps a clearer idea of the seriousness of the pest than the other Java authors.

Miss Wilbrink and Ledeboer[4] also made a study of the disease. They thought that by planting infested cuttings, a certain percentage of sound shoots would result, thus facilitating the elimination of the disease, through selection. They also inclined to the belief that the mosaic was not so much a disease as a vegetative condition (somewhat like the striped and white "sports" of the purple canes), and did not consider it contagious.[5]

Thus it is clearly shown that even these pathologists in Java issued no special warning about the mosaic disease, nor did they, with the single exception perhaps of Kobus, have any clear idea of its serious and entirely incurable nature.

It is worthy of note also that the distinguished Javan expert, Dr. H. C. Prinsen Geerligs, in his book "De Rietsuikerindustrie in de verschillende landen" (1911) while mentioning many other diseases, does not say a single word about the yellow stripe. And Dr. C. A. Barber, another distinguished authority, who has a very special knowledge of the botanical and pathological side of cane work, writing in 1921[6] states: "Our attention was first drawn to this disease, possibly long familiar to us in the cane fields of the tropics, by a lively controversy in the *Louisiana Planter* in 1919."

Thus we see that the only literature about the mosaic disease in oriental countries up to 1917, the Java literature, did not attribute to this pest anything like its true seriousness, and for this reason I repeat that the people in the Argentine and other countries of the new world could not be blamed for importing and spreading a disease about which so little had been published, and to which so little importance was ascribed.

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[1] Lyon, *loc. cit.* [2] *Das Zuckerrohr und seine Kultur* (1899).
[3] Mededeelingen van het proefstation voor de Java-suikerindustrie, No. 12, pp. 320-340 (1907).
[4] *Ibid*, No 39, pp. 433-495 (1910).
[5] *Revista Industria' y Agrícola de Tucumán*, Vol. XI, p. 123 (1921). [6] *I.S.J.*, 1921, 12.

Now let us consider Mr. Lee's facile argument that the mosaic reached the new world through the Argentine's importation of canes from Java, and reached Porto Rico when these varieties were sent on from the South American country. The first recorded importation of canes into the Argentine from Java occurred in the year 1908. But according to Mr. G. L. Fawcett[1] there is good evidence to show that this disease was present in the Argentine as early as 1895, from which date also the gradually decreasing yields of the native canes can be traced. This is also confirmed by the opinion of many of the older planters here, who when the mosaic disease was first recognized stated that the peculiar mottling of the leaves had been noticed by them in the cane many years before the importation of the Java varieties. And another fact is significant. Dr. Kobus in 1908 was asked to come to the Argentine to found the experiment station, and also to send promising varieties of cane with which to initiate his work. He sent the canes and stated the conditions which would induce him to come to this country, and only did not come because the Tucumân Government, through the neglect of a clerk, delayed in confirming the arrangements made tentatively, making him think that perhaps they had lost interest, in a moment when a new contract was offered to him in Java, which he accepted. Now Dr. Kobus at that time had just concluded his noteworthy investigation on the mosaic disease, and would hardly be likely therefore to send infested canes to this country—more especially so as it appeared probable at that time that he himself would have to work with these canes in their new environment.

Mr. Lee says that if these Java canes had been carefully selected in the Argentine before their introduction into Porto Rico, the disease would not have entered this latter country. But as Mr. Earle shows in his "Sugar Cane Varieties in Porto Rico II"[2] these canes were only imported into Porto Rico from the Argentine in the year 1917 On the other hand, Mr J. A. Stevenson in his first circular on the subject "La nueva enfermedad de la Caña"[3] states that already in 1917 the disease had been in Porto Rico for some years (*algunos años*), and in a later publication[4] he gives a map showing the very considerable extension the disease had attained up to July, 1916. "The area already covered at this time indicates" he says "that the disease had been active *for some years at least*, and it is not impossible that it had been present for a much longer time as a minor disease in the upland fields beyond the coastal plain." Referring to investigations made in Santo Domingo in the year 1919 he states: "It thus appears that the mottling disease is widespread in Santo Domingo, occurring not only in the large commercial holdings, but also to a large extent throughout the small scattered native patches. It seems reasonably certain that the disease has been present for many years."

It can thus be proved definitely that the importation of these Java canes is not to be blamed for the introduction of the mosaic disease either into the Argentine, or into Porto Rico from this country.

With regard to Cuba also, Mr. Lee, with equal facility, ascribes the introduction of the mosaic disease to cuttings of Java cane imported from the Argentine. Fortunately, here also we have documentary proof to the contrary. In his annual report for the years 1917-18 the director of the Estación Experimental Agronómica of Santiago des las Vegas, Cuba, Dr. **MARIO CALVINO**, states: (p. 361) "We have also the J 36 . . . . which was sent from Tucumán, Argentina, to Mr. **ARMANDO ETCHEGOYEN**, and given to our station in order that its study under Cuban conditions could be carried out." This appeared under the title "New Varieties Received," implying clearly that it was in that year when the importation was made. And in the next report, Dr. **CALVINO** says: "This cane was imported from the Argentine by Mr. **ARMANDO ETCHEGOYEN**, and handed over to our Estación Agronómica, in order that it might be studied and cultivated *in an isolated plot*, in order to observe whether it was healthy or diseased. The plants did not grow very well and we had to have them inspected several times by our pathologist. Date of planting, 4th December, 1917; date of analysis, 22nd April, 1919 . . . . On the 27th May, 1919, the cane was inspected by Mr. E. W. **BRANDES** . . . who found it to be infested with the mosaic disease"[1]; "for this reason" he continues "*we destroyed everything we had of this interesting cane.*" Now in this same annual report (p. 738), in the pathological section signed by Mr. **STEPHEN C. BRUNER**, pathologist, it says: "Mosaic disease, or Yellow Stripe: This pest is recognized by the presence of numerous short yellow stripes in the leaves; it is very damaging to many varieties of cane; it has been observed in cane fields in the neighbourhood of Cienfuegos, Colón, Mariano, Santiago de las Vegas, and Oriente, but does not seem to have caused damage of any great importance in the country." It will be noted that the districts mentioned are points in Cuba very widely separated one from another. How then, I would ask, could a few cuttings of the Java 36 cane, imported late in 1917, kept in an isolated plot, and afterwards totally destroyed, have produced the distribution of the mosaic disease, in the short space of two years, to the most widely distant parts of the whole island? Especially because, also, according to Dr. **GREY**[2] the mottling disease was not uncommon 18 years before the date of his paper (1919) in the provinces of Matanzas and Havana, and other parts of the island.

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[1] *Rev Ind y Agr de Tuc*, Vol XIII, p. 318 (1922)

[2] *Journal of the Department of Agriculture of Porto Rico*, Vol V, No 3, P 108 et seq (1921).

[3] Circular No. 11, Estación Experimental Insular, Porto Rico, (1917)

[4] The Mottling or Yellow Stripe Disease of Sugar Cane, *Journal of the Department of Agriculture of Porto Rico*, Vol III, No 3 (July, 1919).

It is interesting to note that while Mr. **LEE** intimates that the mosaic entered the western hemisphere through the Argentine, he offers no explanation as to how it got from there to Louisiana, where it was probably present at least as early as 1914, and to which country no shipments of canes from the Argentine are reported before 1920.

I consider it well proved, therefore, that the introduction of the mosaic disease into the Argentine was not due to the varieties of cane imported from Java, and that these canes, when sent from Argentina to Cuba and Porto Rico, were not responsible for the introduction of the mosaic disease there. It is not easy to determine, on the other hand, exactly how the disease did get to these countries, although some facts obtained from the literature throw an interesting light on the possible solution of the problem. As has been indicated, the original source of the infection was probably canes introduced from the Oriental countries, the disease having been recognized in Java in 1892 and in Hawaii and the Philippines around 1908, and probably having been present many years before that. So that any canes introduced into the countries of the new world from these countries can be reasonably suspected of having been infested with the mosaic disease. Now Louisiana has been importing canes from these countries for two generations. Dr. W. C. **STUBBS**, in his book "Sugar Cane," states in this connexion: "In 1890 a box of varieties . . . . was received from Java. It was sent by an enthusiastic planter who was anxious to receive in exchange our varieties. . . . Several single stalks have also at sundry times been received from friends interested in sugar" (page 60). The fact that some of these canes germinated is beyond question, as "Black Java, from Java," and "Batavian, from Java," figure in the list of canes under cultivation at the Audubon Park Station at the time the book was written (1900). In 1887, 13 varieties of cane were received from Hawaii, this being probably the first of a long series of importations into Louisiana from that country. Before 1900 also the Louisiana station had imported the "Tibboo Merd" from "Manilla Islands" (*loc cit.* page 65), which presumably refers to the Philippines.

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[1] Informe de los años 1918-19 y 1919-1920 de la Estación Experimental Agronómica de Cuba, page 554. [2] *Louisiana Planter*, LXIII, 90 (1919).

After these early importations, Louisiana continued importing canes from almost every part of the world, including especially Hawaii, until a comparatively recent date. There is thus no necessity to drag in the Argentine to explain how the Mosaic disease may have been introduced into Louisiana.

As to Porto Rico, this country made importations of cane quite early from Louisiana and Hawaii. In 1904, some ten varieties were obtained from the Audubon Park Experiment Station.[1] The Yellow Caledonia was obtained from Louisiana in 1906, and directly from Hawaii in 1909. As to Javan varieties, at least two were introduced long before the importation from the Argentine in 1917. These are the Java 100, reported by COWGILL in the Fajardo collection in 1914,[2] and the POJ 105, introduced from Egypt around 1913.[3] We have the authority of Mr. LEE himself for stating that when this variety was first sent to Egypt (which was some years before 1911[4]) it is known to have been infested with mosaic, and as this disease is incurable the cane taken to Porto Rico in 1913 must also have taken the mosaic along with it. Many importations of cane were also made into Porto Rico from Santo Domingo, where, Dr. STEVENSON assures us, the mosaic disease has been present for many years.

As regards Cuba, it is not necessary to give references to show that from quite early times many importations were made from foreign countries, particularly Louisiana, Porto Rico, and Hawaii. And as we have seen, the mosaic might well have been introduced in any of these importations. The same applies to the Argentine, where progressive planters had been introducing foreign varieties of cane for years before the Java canes were introduced, and seeing that in many countries the mosaic disease already existed at that time, there is no lack of probability that some of the canes thus introduced should have been infested.

Experiments have been carried out by R O NEUMANN[5] with saccharine for the purpose of determining whether this chemical sweetening agent could replace sugar for beverages, fruit, and the like, in the household. Generally, however, when any marked quantity of sugar was thus substituted a bitter taste became evident.

Attention is directed to the advantages of visitors to London in joining the English-Speaking Union, the Presidents of which are the EARL OF BALFOUR, K G. (British Empire), and the Hon. JOHN W. DAVIS (U S.A.), and the purpose of which is to promote good-fellowship between the British and American peoples *individually*. At the E.-S. U.'s Members' Rooms, Trafalgar Buildings, London, S.W. 1, many of the comforts of a club are available. There is a reception secretary to greet visitors, study their requirements, arrange suitable introductions, plan itineraries, and the like. There is a standing invitation to every American, British, and British Dominion University student to use the club rooms. The subscription, including the membership when travelling to all branches of the Union in this country, the British Overseas Dominions, and the U.S A., is only one guinea, and subscribers also receive an excellent magazine entitled "The Landmark."

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[1] EARLE, *loc cit*, p 35 [2] EARLE, *loc cit*, p 109 [3] EARLE, *loc cit*, p. 110.
[4] H. C. PRINSEN GEERLIGS, *loc cit*, p 320
[5] *Zeits. Untersuch Nahr. u. Genussm.*, 1924, 47, 184-198.

The Australian Sugar Industry.

A Bounteous Season—Embarras de Richesses.

By T. D. CHATAWAY.

The present harvesting season in the sugar districts of Australia—particularly in Queensland—has been one of surprises. The crops are cutting out far better than expected, and the sugar contents of the cane are exceeding expectations and experience. It was anticipated at first that the output of sugar would be less than 50,000 in excess of the 300,000 tons required for home consumption in Australia, but as the season went forward the export of 50,000 tons has taken on the appearance of being nearer 100,000 tons. The Sugar Control Board, which early in the year anticipated its surplus and sold some 30,000 tons of sugar to Britain at a profitable figure, is now faced with the selling of the balance at a considerable loss. The tribunal, created under agreement with the Commonwealth Government, as a set-off to the embargo on the importation of coloured labour sugars, had fixed the price of raw sugars, 94 per cent. net titre, at £27 a ton, but the Board decided to retain £1 a ton against possible losses on export, and since then has increased that sum by a further 10s. This on the now estimated output of 400,000 tons will give a sum of £600,000, which will make up a loss of £6 a ton on 100,000 tons, though as a matter of fact it is known that the first 30.000 tons were exported without loss. There is no question that the policy of the Board of Control has resulted satisfactorily, and justifies its working under the protection of an embargo on imports from Java and other cheap-labour countries. The Board has also been selling sugar to Canada, where there is a preference of about £4 a ton on Empire sugar of a grade corresponding with that made in Australia. This sugar goes direct to Vancouver from such ports as Mackay and Cairns, and thus avoids the heavy costs of conveyance along the coast to Sydney and Melbourne refineries. Still it must be admitted that the industry cannot continue to expand with its present rapidity and make further great losses on its exports, and, after a tour through some of the Queensland sugar districts, Mr. S. M. Bruce, the Australian Prime Minister, has been at some pains to impress this fact upon the producers. If we increase our production, he says, the growers will have to take less for their cane. This is of course admitted, and the growers, should they continue to have bountiful seasons, could afford to take less. Indeed they are already taking less, for we cannot suppose that the mills are bearing the present reduction of 30s. in the price they receive without passing it on to the farmers. The mills run close enough now to actual losses, without adding to them, by shouldering the losses which properly fall upon the growers. The following, extracted from the annual report for 1923 of the Queensland Auditor-General, showing the result per ton at seven mills more or less under Government control, will emphasize this point:—

Mill	Output Tons	Profit or Loss per ton s	d.	
Babinda	21,855	19	6	
South Johnstone	21,030	15	2	
Proserpine	4,526	1	7	
North Eton	2,710	15	11	(loss)
Mossman	10,320	14	4	
Gin Gin	2,626	10	9	
Mount Bauple	2,645	7	3	(loss)

In the above it will be seen that the Mossman made nearly as big a profit per ton as the South Johnstone mill, but only made half the amount of sugar. The former mill was really controlled by a Board of directors chosen by the farmers, the latter mill was directly under Government control. The Mossman also paid the farmers about 10s. a ton more for their cane than did the South Johnstone mill. This seems, incidentally, to support the general argument that Government control is unnecessarily expensive. But the figures of these mills make it clear that the farmers will have to stand the losses on export, and it would seem that in this way a readjustment of cane prices will be brought about without undue friction. There is a natural comparison between the cane-growing suppliers to a central sugar mill, and the fruit-growing suppliers to a proprietary jam factory, and it is upon this point that some striking observations have recently been made. There is a section of the press which still adheres to the old Cobdenite theories. It believes that a bountiful providence should not of necessity help the farmer but should lower prices to the consumer.

COMPLAINTS OF JAM-MAKERS AND FRUIT-GROWERS.

With the news that Australia will produce more sugar than she can consume arises at once a demand that sugar should be reduced in price, and tacked on to that demand we have all the various charges of exploitation and of evils inflicted laid to the door of sugar. I have read that the cost of sugar has restricted the sale of jams, and forced a reduction in the price which the jam-makers have been able to pay for fruits. The fact that the latter have declared substantial dividends is apt to be ignored. There is an ill-defined demand that sugar shall be brought down something like £10 a ton in price. It is sufficient to subtract £10 from the small margin shown in the above table to indicate how ruinous this would be to the manufacturers of raw sugar. I have taken out from the official returns, published by the Commonwealth Bureau of Census and Statistics, some curious figures bearing upon this subject. These show the history of the Australian jam industry. While, during the war years, it flourished exceedingly, and developed quite an export trade, it so raised prices that local consumption was greatly reduced. The value of the jam manufactured is that declared by the manufacturers themselves, who appeal to the pre-war figures in support of their demand that they should be allowed to introduce Java whites, pay £9 6s. 8d. a ton import duty, and all charges. Taking the 1913 price of the best 1A sugar the cost was £23 15s. 0d. a ton, with certain discounts to manufacturers. Then the value of jam was fixed at 3d. a lb. Half the jam consists of sugar, so that the sugar cost 50 per cent. of the jam value. By 1920-21 the jam value had risen to 7d. a lb. and the sugar cost to £49 a ton which means that the jam cost £65 6s. 8d. and the increased cost of sugar £32 6s. 8d. Yet the fruit-growers are persuaded that they have been seriously maltreated. The present price of 1A sugar is down to £37 11s. 4d., or £18 15s. 8d. per ton of jam, but the price of the latter as retailed is still in the neighbourhood of £60 13s. 4d. a ton. A writer in the *Australian Sugar Journal* directs attention to the fact that in 1922-23 the jam exports were valued at no less than £78 6s. 8d. a ton. Sugar producers who have considered these figures are not greatly perturbed at the criticisms in the Southern press and suggest that the fruit-growers should adopt the system of having their own central factories and eliminating the jam-making proprietaries. If that is done the feeling is that the fruit-growers would be paid a proper figure for their products, that the consumers would not be asked too high a price for jams, and, above all, that the export of jam and preserved fruits might swell and so largely absorb any surplus the sugar industry might produce.

THE CELOTEX VENTURE.

I have on more than one occasion referred to the necessity of Australian sugar producers making the best use of the by-products of their industry, but there still seems much hesitation. This I put down to the fact that the cane-growers, who are now making profits, are mostly men of small areas, and of equally small outlook. It is probably four years since I referred to this aspect of the small farmer policy. If the grower does not make a profit he drops out of the business; if, on the other hand, he makes profits he does not seek to enlarge them, except by increasing his area under cultivation. He may see millions of gallons of molasses going to waste, but he does not demand that these shall be converted into motor spirit so that he may employ tractors and abandon the expensive use of horses. He sees cane-cutting gangs making high wages during the harvesting season, yet he will not combine with his neighbour in solving the question of a mechanical cutter, lest he, as an individual, might become a *persona ingrata* to the organized workers, and might suffer some temporary loss at the hands of the incendiarist. Consequently, when some American visitors arrive to spy out the field for a celotex factory, the small farmer is not greatly interested. It is true that the visitors say that in America they pay 10s. per ton for dry bagasse, which would mean the addition of £5 to the earnings of every 100 tons of cane. It is asserted that every ton of bagasse, which may be accepted as 10 per cent. of the sugar cane which goes to the rollers, will produce some £40 worth of what the Americans call lumber, something which will take the place of what we call "three-ply veneer" and other woods used for the manufacture of butter-boxes, fruit-cases and so forth. Naturally, the proposition to invest something like half a million in a factory calls for inquiry as to whether the mills will be willing to sell their bagasse to the lumber-makers. But the Australian sugar people have no keen desire to see new proprietary works in their midst. They at once asked whether it could not be possible to join the visitors and establish co-operative works. There is little question that something along these lines would be an excellent solution of the problem. The mills can well afford to sell their bagasse at 10s. a ton, and in its place use coal, which has three times the steam-raising power, and would certainly not cost 30s. a ton. It happens that throughout the coastal ranges which lie to the immediate west of the sugar districts coal is to be found in many places, and even now is being profitably worked while the sugar districts from Cairns southwards are all linked up by railway. Apart therefore from the possibility of utilizing alcohol from the molasses or oil as a fuel, nature seems to have placed a substitute for bagasse right at the door of the sugar districts. It is in this proposition that one sees not so much increased earnings of the sugar industry as a widening of its vision. The 5000 farmers, with their average of 40 acres of cultivation, will see the importance of using all the by-products of their industry, and with this will come a closer scrutiny of expenditure, and a greater care that there is no waste. They will secure for the cane industry those earnings apart from the actual sugar which made the success of the pre-war sugar beet industry possible. The inevitable reduction in the value of sugar, and consequently the price paid to the farmers for their cane will help to force the latter to consider their position.

THE SUGAR PARLIAMENT.

The half-yearly meeting of the Council of the Australian Sugar Producers' Association has just completed its session. These meetings are moveable feasts, and are held in the various sugar districts and in Brisbane in rotation. This particular meeting was held at Innisfail, somewhat to the south of Cairns. Its representative nature was shown by the fact that, despite the far distant place of gathering, fourteen sugar centres sent delegates, eighteen as representing the growers, and seven the manufacturers. It was natural enough that this parliament should give consideration to the over-production of sugar, and it is to be noted that the feeling was entirely against any proposition to restrict production. It was pointed out that the matter of sugar over-production was not singular, but that in the fruit, maize and dairying industries there is over-production and some means of stabilization is required. By resolution the Council decided that the State and Federal governments should have their attention drawn to the position, and be urged to stimulate immigration, with a view to increasing local consumption, and to urge the British Government to restore the margin of preference on Empire sugar which the late MacDonald Government reduced. The executive of the Council was also empowered to take such other steps as might be deemed advisable. Members made no secret of the fact that they did not seek bounties on exports, such as those granted in the case of other industries, nor did they conceal the fact that through the Sugar Board they were contributing a very large sum towards making good the export losses. Further it was contended that the production next year might conceivably be less than this, not on account of an unfavourable season, but because the large area under cane this year is due to new plantings, which next year will be harvested as ratoons, giving in all likelihood a lower yield. A spirit of independence was exhibited at the Council meeting, which demanded that the Government should hand over to the Association the control of the Sugar Experiment Stations. This is a perennial demand, and is fully justified by the fact that a special levy on the industry is made to maintain stations in the management of which it has no voice. There was no serious accusation that the stations did not serve the industry, but it was felt that much more could be done than at present. For instance there is steady progress being made in the use of paradichlor for the destruction of ours and the European pest, the common cockchafer—*Lepiodiotum albohirta*—but it is argued that under Government control only a section of the sugar areas get the benefit of the progress. Compared with the results in the old days when the catching of a few tons of beetles was regarded as the last thing in scientific control of the grub pest, the modern method of impregnating the land with paradichlor (just mentioned) is promising revolutionary results, not only in regard to the cockchafer grubs but also in the case of white ants. The Council of the A.S.P.A. decided to call upon the government to appoint additional entomologists, and it was even suggested that the Association should subsidize the Government in the matter. This idea, however, would not give the Association control of its own money, and was wisely abandoned. The matter is mentioned here as showing the progressive determination of the Australian Sugar Producers' Association, which must to some extent explain the very strong position it now occupies. Mr. G. H. PRITCHARD, the Secretary, is a member of the executive of the Empire's Producers' Association, an ex-banker of experience, and it was expected that he would be made a member of the new Board of Governors of the Commonwealth Bank. However, this appears to have missed fire, and to that extent the industry may find itself hampered in the handling of its vast output of sugar valued to-day at practically £10,000,000 and ranking next to wool and wheat in importance as an industrial activity of Australia.

A REVERSAL OF FORM.

The fly in the ointment has unexpectedly made its presence manifest. We had said to ourselves that if there were neither frosts nor an early wet season the crop would carry crushing operations right on into the new year. But in actual fact many mills are closing down at the present moment, because the organized labourers on the wharves and ships have been ordered by an executive sitting in Sydney to refuse to work overtime. This instruction is for the purpose of inflicting vicarious penalties upon certain overseas trading companies which employ labour which does not admit the authority of the Australian trades unions. It so happens that the said oversea ships continue their business with very little delay, except at some minor ports, but the sugar ports are now accumulating many thousand tons of unshipped sugar, which, as was shown in the report of the general manager of Government-controlled mills for 1923, amounted in one case in the course of three months to a loss of 7 per cent. of 94 per cent. sugar. At Mackay it is said that already there are 13,000 tons awaiting shipment, and some of the mills have exhausted their storage capacity. In Bundaberg and Maryborough, districts further south, the mills are unable to continue crushing. Thus it has not been frost or early rains which have made the prospects disappointing but the refusal of white men to work in the only industry which is maintaining their alleged faith in a White Australia.

The Mechanical Theory of Sugar Boiling and Curing.

By P. H PARR.

Under modern conditions it is often of considerable importance to the designing engineer for a proposed sugar factory to be able to make reasonably accurate preliminary estimations as to the quantities of massecuite, molasses, etc., to be handled, and hence the machinery capacities required; and of the probable returns of different grades of sugar, for various methods of boiling and curing. With double curing, return of low-grade sugars to process, either as seed or re-dissolved, and so on, the old "rule-of-thumb" methods for the capacities of vacuum pans, crystallizers, and centrifugals are quite useless, and a white sugar factory may require two or more times the machinery in the pan and curing house of that in an old raw sugar factory.

From one point of view, this question appertains to the sphere of the chemist, but as a matter of practical fact, it is nearly always the designing engineer who has to determine the machinery capacities. Moreover, even if the advice of the chemist is sought, experience shows that it is very often found to be either too indefinite to be of practical value from the designer's point of view, or else such an elaboration of machinery is asked for as would prevent satisfactory financial returns being obtained. In general, the designing engineer has to balance the scales between the chemist who would like every elaboration so as to obtain the maximum possible amount of the highest grade of sugar, irrespective of cost, and the purchaser of the machinery, whose only object is to get the greatest monetary return from his expenditure.

In a cane sugar factory, there are two fundamental processes; first, the extraction of the juice from the cane; and second, the extraction of the sugar from the juice, In both operations the working efficiency which will give the maximum financial return depends on many variables, amongst the most important being the cost of labour, cane, and machinery, and the sugar market available. Another very important point is the size of the factory; it is not always fully appreciated that the capacity of sugar machinery increases generally much more rapidly than does its cost, and the same applies to the labour charges for operation, so that, whilst in a large factory, machinery and process elaboration may give highly satisfactory returns, a similar elaboration in a small factory may readily lead to a serious loss.

Returning to the particular subject of these articles, the question the designing engineer has to answer is, given a certain quantity of syrup of a definite—more or less—density and purity, what quantities of massecuite and molasses will have to be handled, and what sugar returns may be expected from certain methods of boiling and curing? On searching, it is at once found that but little information of practical value is available: nearly all published statements, outside definite factory returns, are vague and indefinite. NOËL DEERR[1] points out that theoretically a first massecuite can be boiled to such a concentration as to yield directly an exhausted molasses: the practical reasons which prevent this being done he gives as (1), the massecuite would be too stiff to handle; (2), the massecuite would have to be cooled; and (3), small grain would be produced on cooling. The second objection is negligible, since practically all massecuite is cooled in the crystallizers. It seems to the writer that DEERR has omitted to mention what is really the fundamental reason, which is that the molasses, being very thick and viscous, would adhere so strongly to the sucrose crystals that removal so as to obtain a high purity sugar would be practically impossible: and if heavy washing was done, much of the sugar would be dissolved, so that the resulting mixed molasses would no longer be of exhausted quality. The difficulty lies in the separation of the molasses from the crystals, sooner than in the handling of the massecuite as such. The old *s*, *j*, *m* formula tells us what return we shall obtain if a massecuite of given purity is separated into sugar and molasses of other given purities, but leaves undetermined the question as to whether such a separation be practicable or no. A consideration of this question is really the basis of the following work.

Before entering into detailed calculations, it will be well to state definitely the assumptions on which the following mechanical—as distinct from chemical—theory is based.

Massecuite is assumed to consist of a mixture of molasses and of crystals of pure sucrose. *Molasses* is assumed to be water, saturated with sucrose in solution, and containing also the whole of the non-sugars, or impurities. *Sugar*, as discharged from the centrifugals, is assumed to consist of the sucrose crystals from the massecuite, with a thin adhering film of molasses, the amount of which determines the purity of the sugar. These assumptions are in substantial accordance with chemical analysis, the chief divergence being that the sucrose crystals contain a small proportion of the mineral ash—it is highly probable that a particle of ash forms the nucleus around which each sucrose crystal is formed—and, when deposited out from low purity liquors, the crystals contain also a small percentage of other impurities. In any case, the accuracy of these preliminary assumptions is much greater than that of the final accuracy to be expected.

The most uncertain point of all is the amount of sucrose required to saturate one unit of the water in the molasses. The solubility of sucrose in pure water at different temperatures has been determined with considerable accuracy, but the non-sugars in the molasses affect the solubility of the sucrose. With beet molasses, the non-sugars present are usually such as to increase the solubility of sucrose: with cane molasses, their effect is very variable, but is usually such as to decrease the solubility of sucrose. For present purposes, it will be assumed that the solubility of sucrose in the water component of molasses is the same as that in pure water, and the values used for the numerical results in these articles are as given in the Table below: although not quite the most modern determinations, the errors are negligible in comparison with the uncertainty and variability of the effects of the non-sugars in solution. The solubilities stated are in parts by weight of sucrose dissolved by one part by weight of water at the temperatures given.

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[1] *Cane Sugar*, p. 384.

Temperature °C.	Solubility.	Temperature °C.	Solubility.
30	2·12	55	2·67
35	2·20	60	2·83
40	2·30	65	3·00
45	2·40	70	3·18
50	2·52	75	3·41

The symbolization adopted is as follows, and the term "solids" is used instead of "Brix" in order to draw attention to the fact that in all calculations of this nature it is essential to use absolute values only. In a few instances, the probable Brix and polarization values are given, estimated according to the Table given previously by the writer,[1] but absolute values only are used for the calculations. All values must be taken decimally, so that 92 per cent. solids is 0·92, 70 per cent. purity is 0·70, and so on.

S = weight of solids ÷ total weight;
P = purity = sucrose ÷ solids;
V = sucrose solubility;
W = non-sugars ÷ water;
M = total molasses ÷ total massecuite; and
K = water in sugar ÷ sucrose crystals.

With reference to W, the ratio of the non-sugars to the water in the molasses, since the amount of water is $1-S$, and the amount of non-sugar is $S\,(1-P)$, we have:—

$$W = \frac{S\,(1-P)}{1-S}$$

With reference to the ratio K, defined as (water in sugar) ÷ (sucrose crystals), the writer has found, after trying various methods, that the use of this ratio appears to give the most satisfactory results, and those most nearly in accordance with practice, whilst giving reasonable simplicity to the mathematical work.

It is necessary to distinguish between massecuite, molasses, and sugar, and the suffixes 1, 2 and 3 will be used to indicate these respectively, so that S_1 is the solid content of the massecuite; P_2 is the purity of the molasses; P_3 that of the sugar, and so on.

Now considering the massecuite, with solid content S_1 and purity P_1, this consists of M molasses and $1-M$ sucrose crystals: the total sucrose is $S_1\,P_1$, and the sucrose in solution is $S_1\,P_1-(1-M)$: the total non-sugar is $S_1\,(1-P_1)$: and the total water is $1-S_1$, per unit weight of massecuite.

Next, the total molasses contained in the massecuite is M, and is without any sucrose crystals: the sucrose in solution is $V\,(1-S_1)$, which is identical with the $S_1\,P_1-(1-M)$ mentioned for the massecuite: the non-sugar is $W(1-S_1)$, which is the same as the $S_1\,(1-P_1)$ for the massecuite: the total solid content is $(V+W)\,(1-S_1)$; the water is $1-S_1$; and the total weight is $M=(1+V+W)\,(1-S_1)$.

Then, for the separated sugar, this contains the whole of the sucrose crystals from the massecuite, or $1-M$; the water entrained by these crystals will be $K\,(1-M)$, containing $KV\,(1-M)$ sucrose in solution, so that the total sucrose in the sugar will be $(1+KV)\,(1-M)$; the non-sugar carried by the water will be $KW(1-M)$; the total solids will be $\{1+K(V+W)\}(1-M)$, and the total weight will be $\{1+K(1+V+W)\}(1-M)$.

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[1] *I.S.J.*, June, 1924, p. 311.

Finally, the purity of the massecuite is P_1, that of the molasses is $P_2 = \frac{V}{V+W}$, and that of the separated sugar is $P_3 = \frac{1+KV}{1+K(V+W)}$; the solid content[1] of the massecuite is S_1, that of the molasses is $S_2 = \frac{V+W}{1+V+W}$, and that of the sugar is $S_3 = \frac{1+K(V+W)}{1+K(1+V+W)}$.

As these values are continually required, it is useful to recapitulate them in tabular form, thus:—

PER UNIT WEIGHT OF MASSECUITE.

	Massecuite	Molasses.	Sugar
Sucrose crystals..	$1-M$	0	$1-M$
Sucrose in solution..	$S_1P_1(1-M)$	$V(1-S_1)$	$KV(1-M)$
Total sucrose..	S_1P_1	$V(1-S_1)$	$(1+KV)(1-M)$
Non-sugar.	$S_1(1-P_1)$	$W(1-S_1)$	$KW(1-M)$
Total solids..	S_1	$(V+W)(1-S_1)$	$\{1+K(V+W)\}(1-M)$
Water	$1-S_1$	$1-S_1$	$K(1-M)$
Total..	1·00	$M=(1+V+W)(1-S_1)$	$\{1+K(1+V+W)\}(1-M)$
Purity	P_1	$P_2=\frac{V}{V+W}$	$P_3=\frac{1+KV}{1+K(V+W)}$
Solids ..	S_1	$S_2=\frac{V+W}{1+V+W}$	$S_3=\frac{1+K(V+W)}{1+K(1+V+W)}$

The recovery of sugar = R = (solids in sugar) ÷ (solids in massecuite), is usually most conveniently calculated from the well known relation $R = \frac{P_1-P_2}{P_3-P_2}$, although, if desired, it may equally well be found from the equivalent $R = \frac{\{1+K(V+W)\}(1-M)}{S_1}$, and the sucrose recovery, (sucrose in sugar) ÷ (sucrose in massecuite), is $R^1 = R \times \frac{P_3}{P_1}$, or $\frac{(1+KV)(1-M)}{S_1P_1}$.

The value left indefinite in the above analysis is that of K, or the amount of water entrained by the separated crystals. A consideration of working results seems to show that the value of K depends chiefly on the purity of the molasses, and a relation of the form $K = \frac{1-P_2}{N}$ gives generally fair results. N lies usually between 10 and 20, and varies somewhat with the temperature (the fluidity of the molasses), and the size of the crystals but, in the absence of more detailed information, a value of $N = 15$ gives very fair all-round results, and this figure has been adopted for the further numerical work.

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[1] It should be noted that M is the total molasses in the massecuite, and the molasses separated on curing is $M\left\{1-\frac{K(1-M)}{1-S_1}\right\}$, or massecuite − sugar.

After this somewhat tedious mathematical analysis, it appears to be desirable to make a numerical application of the formulæ obtained, in order to show the kind of results given, and we will first consider the case of a massecuite of 0·80 (80 per cent.) purity, boiled to 0·91 solid content, and cured at a temperature of 70°C. We have given $S_1 = 0{\cdot}91$ and $P_1 = 0{\cdot}80$, and from the solubility table, $V = 3{\cdot}18$ at 70°C. The ratio of non-sugar to water is $W = 0{\cdot}91\ (1 - 0{\cdot}80) \div (1 - 0{\cdot}91) = 2{\cdot}02$. The total weight of molasses in unit weight of massecuite will be $M = (1 + 3{\cdot}18 + 2{\cdot}02)\ (1 - 0{\cdot}91) = 0{\cdot}558$, and the weight of sucrose crystals will be $1 - 0{\cdot}558 = 0{\cdot}442$. The purity of the molasses will be $P_2 = 3{\cdot}18 \div (3{\cdot}18 + 2{\cdot}02) = 0{\cdot}612$, with a solid content of $S_2 = (3{\cdot}18 + 2{\cdot}02) \div (1 + 3{\cdot}18 + 2{\cdot}02) = 0{\cdot}839$. Taking $N = 15$ gives $K = (1 - 0{\cdot}612) \div 15 = 0{\cdot}026$, from which it will be found that the sugar contains 0·478 of sucrose per unit weight of total massecuite, of which 0·442 is in crystalline form; the solid content is $S_3 = 0{\cdot}978$ (or 2·2 per cent. moisture), and the purity is $P_3 = 0{\cdot}953$; the recovery of solids is 0·551, and of sucrose 0·656.

The Brix, etc., values commonly used for factory control, corresponding approximately to the above absolute values,[1] are :—

	Massecuite.	Molasses.	Sugar.
Brix	93·2	87 8	98·4
Polarization	71·0	48 0	92·8
Apparent purity	76·2	54 7	94·3
Gravity purity	78·1	58·5	94 7

If this massecuite, instead of being cured at 70°C., is cooled down in the crystallizers to 50°C., then W will not be affected, but according to the solubility table V will be reduced from 3·18 to 2·52, a corresponding amount of sucrose being crystallized out. Using this new value for V, and making the calculations in the same manner as before, it will be found that the purity of the molasses is reduced to 0·555, and its solid content to 0·819; the recovery of solids is increased to 0·623, and of sucrose to 0·738, but the purity of the sugar is reduced to 0·948. Again transforming to Brix, etc., values, we have :—

	Massecuite	Molasses	Sugar.
Brix	93·2	86·3	98·1
Polarization	71·0	41·8	91 9
Apparent purity	76·2	48·4	93·7
Gravity purity	78·1	52·7	94·2

This shows that, so far as the mechanical theory is concerned, cooling the massecuite in crystallizers results in a higher yield of sugar, but of a somewhat lower quality. Mechanically, exactly the same result would be obtained by boiling the massecuite to a slightly higher concentration, and curing at the higher temperature. Actually a certain time is required between boiling and curing, even when the latter is done "hot," the reason being more physical than chemical. The mother liquor in the massecuite as discharged from a vacuum pan is always supersaturated with respect to sucrose, and, given time, even without any reduction of temperature at all, a certain amount of sucrose will crystallize out. Such fine points as these, although of very great importance in practical working, are entirely beyond the scope of these articles, whilst in any case, the particular values depend on the exact composition of the molasses as distinct from its purity, and generalizations are quite impossible. This is where the sugar chemist and the pan-boiler take charge, and each massecuite has to be dealt with as it there is.

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[1] *I.S.J., l.c.,* p. 311.

If our massecuite of 0·80 purity be boiled only to 0·90 solids instead of to 0·91, and cured at 70°C., the resulting sugar will be of 0·962 purity, with a solid recovery of 0·500 and a sucrose recovery of 0·601.

An examination of these figures shows that cooling of the massecuite of 0·80 purity and 0·91 solids by 20°C., from 70 to 50°C., increases the recovery by 13 per cent., but reduces the sugar purity by half a point: whilst boiling to 0·90 solids only, instead of 0·91, reduces the recovery by 9 per cent., but increases the sugar purity by one point. This shows that the recovery is very sensitive with reference to the massecuite concentration and to the curing temperature, so that, in order to obtain a massecuite from which a sugar of a specified purity will be obtained on curing, the concentration of the massecuite and the temperature of curing must both be controlled within very fine limits, which will vary not only with the purity of the massecuite, but also with its exact composition. We here find a theoretical explanation of the well-known practical fact that it is actually best to boil the massecuite to a concentration slightly higher than will permit of straight curing to the required sugar purity, and then to wash off in the centrifugals just so much of the adhering molasses as will suffice to raise the sugar purity to the required point. By this method, the maximum recovery is obtained, whilst if the massecuite concentration was kept low enough to ensure the required sugar purity from straight curing, without washing, then probably the sugar purity would be a few tenths higher than necessary, without any appreciable commercial advantage, but with a comparatively great loss in the recovery.

It will readily be appreciated that the difference of a point or two in the massecuite concentration is absolutely negligible so far as evaporation and machinery capacity are concerned, and fairly accurate estimations can be made of these: but the actual working concentrations may and almost certainly will be slightly different from the estimations. Calculations are of little use for the actual working, though they may offer a preliminary guidance, and hence the pan boiler is one of the most highly skilled and important of the factory operatives, in spite of the remark by a friend of the writer, with considerable experience in Central America, that "any one can make sugar in a vacuum pan, but it takes a really good man to boil muscovado properly."

(*To be Continued*)

Speaking of Kenya as a cane-growing country, Mr. G. R. MAYERS[1] (Managing Director of the Victoria Nyanza Sugar Co., Ltd.,) says that there is no defined season, and in the Nyanza Province the rains seem to come "at any odd time," as was experienced last season, when the conditions much decreased the output of sugar.

Circulators for boilers are being well regarded by many engineers, the principle being of course that in order to secure the greatest heat transmission there should be a constant and uniform movement of the water throughout all parts of the generator. In one type, which appears to be well favoured, the circulator is designed "to imprison a number of convection currents, and maintain them as convection currents free of any admixture of steam, but characterized by a greatly accelerated rate of flow." During the circular journey, mud, oil, or air, or all three, if present, are carried upwards by the flow, passing through a settling chamber in which they are deposited and removed from time to time. If efficiently performed (as claimed), the advantages of such a service in respect of fuel economy, reduction of scaling, diminution of pitting and priming are obvious, and a good number of boilers are now being equipped with a type of circulator working on this principle.

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[1] *South African Sugar Journal*, 1924, 8, No. 10, 753.

Juice-Strainers, Juice-Heaters, Settling Tanks, the Petree-Dorr Process, and the Kopke Clarifier.[1]

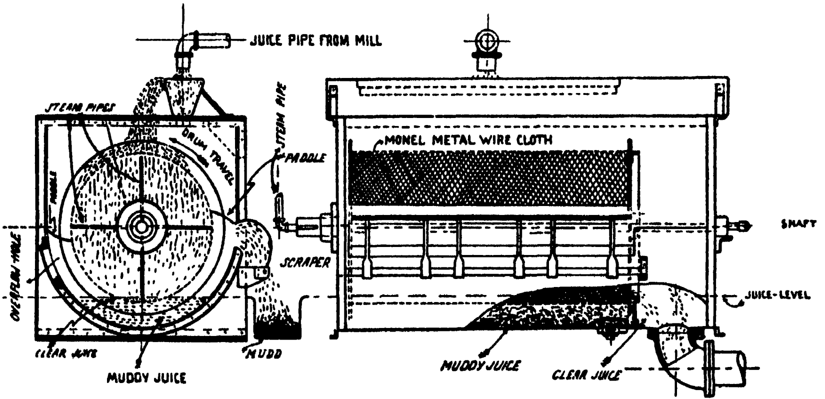
By G. H HALDEN

THE PECK JUICE STRAINER.

The greater portion of the suspended impurities can be removed from the juice by passing it through a fine mesh screen. This separation should take place as soon as possible after the juice leaves the mill, and before the juice is subjected to heat and clarifying agents ; the separated impurities, after the greater part of the liquid has been drained off, should be sent back to the mill, while the juice proceeds to the boiling house.

The Peck Juice Strainer[2] has so far not been put into use in the Philippines, but that its potential merits are now generally recognized is demonstrated by the fact that the Hawaiian-Philippine, Del Carmen, Talisay-Silay, San Carlos, and Calamba factories have recently installed or have ordered this apparatus.

Regarding it, Mr. ROBERT E. HUGHES wrote :—"This strainer did wonderful work, removing great quantities of 'cush-cush,' a large percentage of which, when washed, would pass through a 100-mesh screen, indicating that the 'cush-cush' itself was acting as a filtering medium. In this manner a considerable amount of grit and mud was removed. The strainer was 3 ft. in diam. by 6 ft. long and took care of the primary juices (in the Petree Process) while grinding at the rate of 155 short tons of cane an hour with dilution of 46·63 per cent."



ARRANGMENT SHOWING OPERATION OF PECK'S JUICE STRAINER

Again, Mr. DEAN G. CONKLIN has stated on the Peck Strainer :—"The raw unlimed juice was sent through a 100-mesh Peck screen before going to the heaters, but on account of all of the *bagacillo* being removed from the juice it was at first difficult to obtain a firm press-cake. This difficulty was, however, overcome by heavy liming of the settlings, which were brought almost to the boiling point in blow-ups, and sent to the presses under 25 lbs. pressure. The runnings from the presses were highly alkaline and were returned to the raw juice, the addition of lime to the raw juice being reduced proportionately."

While the practice of reheating the heavily overlimed settlings and returning the resulting filtrates to the mixed juice may not have any appreciably bad effect on juices of a high purity and low glucose content, we are of the opinion that it is a practice which should, if possible, be avoided. The same object, that is a firm press-cake, might be attained by the addition of kieselguhr or other filtration aid to the settlings, or by increasing the volume of the settlings by the addition of clarifying agents forming a more bulky precipitate than that due to heat and lime alone.

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[1] Abridged Report of the Committee on Manufacturing Machinery presented to the Second Annual Convention, Philippine Sugar Association.

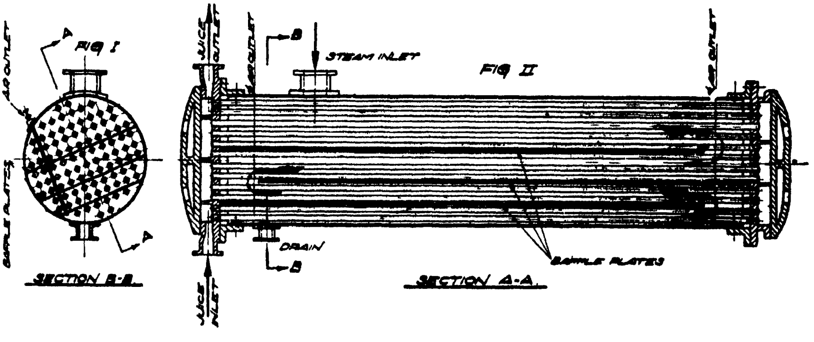
[2] U.K. Patent, 206,928 ; *I.S.J.*, 1924, 168 ; also 1924, 650.

JUICE HEATERS.

The horizontal type designed for high velocity with several changes of direction of the flow of juice is the usual type of heater found in the Philippines. Excellent results have been reported with the "Special H. I. W. Juice Heater with Baffles." [1]

It is claimed that while the ordinary type of horizontal juice heater without baffles can readily heat 60 lbs. juice per sq. ft. hour from 80° to 212°F. with 4 lbs. steam pressure, the new design of heater with baffles will heat double that amount of juice per sq. ft. hour.

Each cell has 20 passes of tubes 15 ft. long; the juice velocity is figured at 5 to 6 ft. per second and the amount of juice per sq. ft. hour heated from 80° to 212°F. is 112 lbs.; while steam is at 4 to 5 lbs. gauge. The cells are provided with means to eliminate incondensible gases.



SPECIAL H.I.W. JUICE HEATER WITH BAFFLES.

The reason for the greater capacity of this new heater compared with the old is due to four important conditions brought about in this new design. (1) Inducing the flow of heating steam at a greater velocity; (2) Making the flow of steam counter current to that of the juice; (3) Removing the condensate from the heating surface as soon as it is formed and conducting it away from the banks of tubes below; and (4) Removing incondensible gases from the body.

A number of new heaters have been made and old cells have been changed into the baffled type, giving results better than stated above.

SETTLING TANKS.

Settlings should not form more than from 10 to 15 per cent. of the total juice Clear juice leaving the settling tanks on its way to the evaporators should be run through a fine mesh screen in order to intercept suspended impurities which may accidentally accompany the juice. While not specially designed for this, we see no reason why the Peck Juice Strainer should not be suited to this purpose. Screens having as many as 200 perforations to the linear inch have been used, but the more common sizes range from 100 to 150 mesh.

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[1] See *I.S.J.*, 1922, 81-82.

The usual time required for settling lies between 25 and 45 mins., and the whole cycle of filling, settling and emptying should take less than two hours in the intermittent system of settling and decantation; one may, therefore, expect the greater part of the juice, or about 85 per cent., to enter the evaporators within two hours after it is extracted from the cane, the balance of the juice accompanying the mud to the filter-presses.

THE PETREE & DORR PROCESS.

The writer of this article has no first hand knowledge of this process. He remarks however that in the ordinary process of defecation the time required for the greater portion of the juice to reach the evaporators can safely be said to be less than two hours; whereas it is understood that a Dorr Clarifier, or subsider, is supposed to be large enough to afford storage capacity for the juice from four hours grinding at maximum rate; therefore, the least time required for the juice to reach the evaporators is four hours.

We may postulate that a minimum loss of 0·35 parts sucrose per 100 sucrose in cane is the unavoidable consequence of installing the Petree-Dorr Process, it being assumed that the juice has a sucrose content between 10 and 15 per cent., and that it is kept at a temperature between 90 and 100° C for not less than four hours.

The above considerations refer only to the juice from the primary subsider, which it is claimed represents as much as 95 per cent. of the total juice. The balance of the juice, or 5 per cent. of the total, accompanies the mud to the mills, where it is united with the dilute juices from the intermediary mill or mills, and, together with these, after passing through a heater, forms the content of the secondary juice subsider, wherefrom it again is united with the juices from the first part of the mill train, and after being heated again passes into the primary subsider to undergo another four-hour treatment, before it finally finds its way to the evaporators. We do not know the time the juice remains in the secondary subsiders, but we believe, two hours to be a fair estimate. If this is correct, then ten hours have elapsed from the time that 5 per cent. of the juice was expressed by the mills until that same juice enters the evaporators, and this juice has during this time been heated three times to the boiling point.

The above statements may be looked upon as being entirely too pessimistic (particularly as the writer claims no first-hand knowledge of the process) but while our criticism is based entirely upon a theoretical point of view, the points raised appear to be of sufficient importance to justify investigation[1].

CENTRIFUGAL CLARIFICATION.

In the usual running of the filter-press station in connexion with the defecation process one can expect a loss of about 0·2 to 0·4 sucrose per 100 sucrose in the mixed juice. The actual loss in the majority of factories is somewhat larger, on account of undetermined losses due to deterioration, which are not recorded by the routine methods of chemical control. The elimination of the filter-press station is, therefore, something that every sugar-house man would welcome with enthusiasm.

We have followed the development of the centrifugal clarifier with great interest, and it is with pleasure that it is noted that this machine evidently now has reached mechanical perfection. Several Kopke centrifugal clarifiers are being installed this year in Hawaiian factories. Details of the latest developments are not at hand at this writing, but we understand Puunene has ordered four 40 in. water-driven machines, and that one of the other large Hawaiian factories is contemplating an installation of six 40 in. electrically-driven clarifiers. It appears, in general, that one of these machines 30 in. diam., takes care of the mud from 17 tons of cane per hour, and it would appear that a 40 in. machine would treat the mud from about 28 tons of cane per hour. Puunene, will use the centrifugal clarifiers only for handling the mud.

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[1] See also *I.S.J.*, 1924, 651.

About ten years ago the writer of this paper had the privilege of visiting a Hawaiian factory where Kopke clarifying centrifugals were being installed ; the whole lay-out made an exceedingly favourable impression, and the writer was struck by the great possibilities of this machine. For some reason or other the installation was later dismantled, possibly due to some slight imperfections in the machine, but the underlying principle certainly is sound. Its performance in Hawaii will be watched with the greatest of interest. The clarifying centrifugals took the place of settling tanks and mud-presses.

The *modus operandi* was as follows :—Limed and heated juice coming from the heaters was delivered through a pipe line direct to the clarifying centrifugals, this line being connected to a surging tank that took care of any momentary variation that might occur in the delivery from the heater to the centrifugals. The heated juice flowed through suitable nozzles to a receiving chamber at the bottom of the revolving centrifugals. While the juice travelled from the bottom of the machine to the overflow at the top, the solid and heavier impurities were separated and held by centrifugal force in a dense state in the outer periphery of the bowl, the clear juice overflowing at the top. The clear juice collected in the outer stationary tub, was discharged into a trough and pumped direct to the evaporators.

When the accumulation of solids (mud) in the bowl had reached a certain depth, the supply was cut-off. The juice which remained in the bowl on top of the mud was then displaced by water, and the mud together with the water was discharged by means of a mechanical discharger into a conveyor leading to the mud mixing tank, where water was added. The amount of water can be gauged so, that any desired density and predetermined loss in the final mud may be obtained. Then this diluted mixture was delivered to the mud treating clarifying centrifugals. The sweet-water was separated from the mud and was disposed of in the usual way, the mud being discharged from the machines through a conveyor to cars outside the building.

The sugar content of the mud is easily kept below 1 per cent. with a dilution that is much less than is required in filter-press practice ; and the exhaustion of the mud is accomplished in a fraction of the time usually required. Over 98 per cent. of the total juice is clarified and delivered to the evaporators at a temperature of 206°F. in much less time than it would have been delivered to the settling tanks of the old system.

Recent work by Dr. J. Kuyper[1] carried out on 26 acres in Java to ascertain the rate of deterioration of cane between cutting and milling showed preliminarily that in such investigations small samples of 20 or 30 stalks give results that are misleading. Much larger lots must be drawn from in sampling, e g., an entire truck load, and each test should be made several times. Some of the conclusions arrived at as the result of this work were : That the Brix hardly changes two days after cutting ; that the purity falls continually (the rate being 3-4° in two days) ; and proportionately that deterioration is more rapid with cane exposed to the sun than that kept in the shade Cane should be milled within 48 hours after cutting, in order to avoid a somewhat considerable loss

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[1] *Archief*, 1924, 32, *Mededeel No.* 2, 27-54.

The Home Sugar Trade during 1924.

Messrs. William Connal & Co's. Annual Review.[1]

The year.—During the past year America has continued to exercise its controlling influence over the sugar markets of the world, and as this influence is dependent in great measure on the Cuban crop, the movements of that crop are always followed with deepest interest.

When the market opened in January there was an impression that the Cuban crop then commencing was not likely to exceed its predecessor of 3,660,000 tons, and as this was considered insufficient to satisfy increasing consumption, it was felt that a high level of values might possibly be looked for. A large daily business was then being done in America, in new crop Cuban sugars, at the equivalent of 26s. to 26s. 6d., c.i.f., for the United Kingdom. America was then the only market from which supplies of importance could be obtained, and, as both European and Canadian refiners were desirous of increasing depleted stocks, they became anxious buyers in that market at the full price then ruling. So great had been the demand for Cuban during January, that at the close of the month, it was estimated that about 1,000,000 tons of that crop had, till then, been disposed of.

In February there was active buying on the part of both America and U.K. refiners, which caused an advance of 6d. to 9d. per cwt., and which raised the quotation by the middle of the month for Cubans to 30s. 6d., c.i.f., for the U.K. This proved the highest point of the market during the year. A large business continued to be done during the latter weeks of February, but at prices which were a shade easier, and at the close of the month the quotations were 29s. 3d. to 29s. 6d., c.i.f , for the U.K.

During March there was a quieter tone. The market for refined sugar in America had become highly unsettled, and, as a consequence, had unfavourably affected the position of raw, which suffered a gradual decline, till, at the close of the month, the quotation for Cubans had fallen to 26s., c.i.f., for the U.K. The dulness at this point was intensified by the report of Mr. F. O. Licht, of Magdeburg, that the sowings for the next Continental beetroot crops were to be largely increased—probably to 1,975,000 hectares, against 1,633,000 hectares for the previous crop.

During April unsettled conditions prevailed both in Europe and America, and a poor demand for refined caused dull and declining markets. A report from the U.S. Department of Agriculture, which was then published, estimated the Cuban crop at 3,813,000 tons, and, although a similar figure had previously been given by Mr. Himely, it had nevertheless an unfavourable effect, and caused a severe drop in the terminal market and lowered the quotation for Cuban to 25s. 9d., c.i.f., for the U.K. From continued unsettlement of the American market, and forced sales being made there by operators, a further decline took place in the value of raw, until 24s. 9d., c.i.f., came to be accepted as the value of Cubas. The Budget, taken on 29th April, made a sweeping reduction of 14s. per cwt. or 1½d. per lb. from the sugar duties. It was expected that this important reduction might largely increase the consumption of sugar, and possibly cause an improvement in values, but this was rendered impossible by the continued unsettlement of the American market.

Early in May increased estimates of the Cuban crop were published, first by Mr. Guma, who found that a higher yield of the canes, and beneficial rains, had caused an increase from his previous estimate of 3,750,000 tons to 3,900,000 tons, while Mr. HIMELY followed by raising his previous estimate of 3,813,000 tons to 3,985,000 tons. From another independent source even 4,000,000 tons were confidently predicted. These increased figures caused further depression, which was increased by forced sales in the American market by weak holders, and, with no redeeming feature, Cubas were forced down to 22s., c.i.f., and later to 20s., c.i.f., for the U.K. At the end of May estimates were again increased by Mr. GUMA to 4,075,000 tons and by Mr. HIMELY to 4,050,000 tons, and the effect of these new figures caused further depression, which forced Cubas down to 18s., c.i.f., for the U.K.

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[1] Abridged from the Review, published by Wm. Connal & Co., Victoria Buildings, Glasgow

During June and July there was no feature of special interest—with any improvement in the value of refined there was a temporary advance, which, with any relapse, was again lost. Some forced sales of Philippines in America in July prevented any prospect of improvement there for the time being. The first cargo of new Mauritius was placed for the U.K. in June at the equivalent of 20s. 1½., c.i.f., when preference is taken into account. The new Java crop then being reaped, under favourable conditions, was estimated at 1,840,000 tons—the greater part of this crop, however, was destined to find a market in the East.

During August there was little change to record Cubas ranged from 17s. 6d. to 20s. 1½d. with little or no business passing to the U.K A cargo of 8,000 tons Mauritius was then purchased by Canada, and 30,000 tons of Australian raw by London.

Early in September a few cargoes of Cuban and San Domingo sugars were placed for the U.K. at 19s. 6d. to 21s., c.i.f., but thereafter the balance of these old crop sugars was all required by American refiners to supply their wants until new sugars become available in December. The U.K. refiners found the only sugars available during these latter months were Peruvians from 20s. 9d. to 16s. 6d., c i.f., Mozambiques at 20s. 1½d. to 19s., and new crop Polish beetroot, of which a considerable quantity was obtained from Danzig, at 19s. 10½d., c.i f., for October shipments to 15s. 6d., c.i.f., for shipment in December.

The Cuban crop.—The new Cuban crop, although somewhat delayed by abnormally rainy weather, and from threatened labour troubles, made a satisfactory commencement early in December with three Centrals, which were speedily followed by many others. The condition of the crop had been reported to be highly favourable, and it had been estimated by Messrs. WILLETT & GRAY at 4,300,000 tons, but as work proceeded it became evident that this estimate was much too low, and early in December Messrs. LAMBORN predicted a crop of 4,500,000 tons, followed by an estimate from Mr. HIMELY of 4,620,428 tons, and thereafter by Mr. GUMA of 4,724,714 tons, while by another party, who had visited the island and had inspected the cane fields, it was estimated at 5,000,000 tons. These important figures have caused a weaker market. The early sugars, being required by American refiners, have not suffered so severely as later deliveries. Business is reported to have been done for January shipment at 14s. 9d. to 14s 7½d., c.i.f., and for February at 13s. 10½d. to 13s. 9d., c.i.f. Buyers, however, have shown great caution, and prefer to await developments, unless lower prices can be accepted for early shipments.

American beetroot crops.—From favourable weather these crops have exceeded their first estimates, and are now reported to be 875,000 tons, against 787,000 tons last season. Notwithstanding the bounty of 8s. 1d. enjoyed by this, and all other crops of American-grown sugars—namely, those of Louisiana, Porto Rico, Hawaii, and the Philippines—their out-turns show no increase of importance. Lately, when an effort was made to obtain a reduction of the Cuban duty, the localities mentioned, which pay no duty, but market their crops at the duty-paid price, made strong, and successful, representations to President COOLIDGE to make no change, on the plea that any reduction of duty, and consequently of their bounty, would prove disastrous to them. The Canadian crop has increased to 20,000 tons, and an effort is being made for a revival of interest in the extension of that crop.

Continental beetroot crops.—From more extensive sowings, and favourable weather, these crops show an increase over those of last season of about 2,100,000 tons, and they are now estimated at 7,143,000 tons, against the previous crop of 5,057,000 tons. The largest pre-war crop in 1913 was 8,475,000 tons, which figure may shortly again be reached. The crop, which meantime tells most severely on the British refiner is not that of Germany, but of Czecho-Slovakia, of which about 1,000,000 tons are available for export, and principally as white sugar, and, being of excellent quality, they become formidable opponents.

It is of interest to observe that in the pre-war year 1913 the world's crops consisted of 7,007,014 tons of cane and 8,475,000 tons of beet, whereas now they are 14,099,000 of cane and 8,038,000 tons of beet.

Home-grown beetroot crops.—Three factories worked this season—namely, the two previous factories of Cantley in Norfolk and of Kelham in Notts, and in addition that of Colwick, also in Notts. The two old factories produced over 20,000 tons of white refined granulated, and the new factory rather over 3,000 tons.

Refined.—A very considerable falling off of meltings by Clyde refineries has to be recorded this year. One, the smallest, has been silent since July, but an ill-advised strike of the workers early in October brought the remaining four to a standstill. Sympathetic strikes by carters and quay workers made matters worse, and as a result one refinery, that of Messrs. NEILL, DEMPSTER & NEILL, has been definitely closed, after about three-quarters of a century's activity. This will prove a serious loss to the town of Greenock. The strikes terminated about the end of November, but only one refinery had raws and was able to resume on a moderate scale about the middle of December. The others will probably resume when Cuban raws become available in quantity, which may not be till well on in February, unless supplies of raw beetroot are earlier obtainable at prices to allow of a refining margin. This, however, would not prove helpful to the largest Greenock refinery which has always used cane only. Compared with last year 48,319 tons less were melted.

At the beginning of January the price of Greenock fine granulated was 58s. per cwt., duty paid. The supplies of Continental refined sugars were then small, as Czecho-Slovakian sugars could not be shipped on account of the Elbe being frozen, and, in addition, American refiners were fully occupied with the supplying of their own markets. In consequence there was a gradual hardening of prices until 62s. 6d. was reached by the middle of February. This price was held till early in March, when the prospect of German exports of refined, and the early release of Czecho-Slovakian sugars caused the market to decline. American granulated was also then being offered, but at unattractive prices. The expectation that there would be a reduction of the sugar duty in April caused consumers to adopt a cautious policy, buying only for actual requirements, which greatly assisted the fall. Just before the introduction of the Budget, at the end of April, the price had fallen to 57s. 9d., and even the substantial reduction of 14s. per cwt. in the duty failed to steady the market. The expectation of a record Cuban crop confirmed buyers in their policy of caution, and from 43s. 6d., the price on the introduction of the lower duty, the decline went on till 36s. was reached in June. Thereafter the market improved in sympathy with American markets, and early in July 38s. 6d. was paid for Greenock fine granulated. Heavy shipments of white sugars from Java to the U.K. then began to hang heavily on the market, and by the end of the month the price had fallen to 36s. 6d. Offerings of Continental sugars were then small, and later quite ceased, and the Continent became an eager buyer of the white Javas arriving in U.K. ports. In September there was a scarcity of sugar and the price touched 40s., but the expectation of greatly increased beetroot crops, however, caused buyers again to adopt the hand to mouth policy, and the new crop sugars came on the market at almost daily declining prices. When the Greenock strike started in October the quotation had fallen to 37s. 6d., and the last of the sugars then made were sold at 35s. At the close 32s. is the quotation of the one refinery at work.

During the first three months of the year business in foreign refined was principally confined to Dutch, Belgian, and American granulated. As already mentioned, Czecho-Slovakian sugars could not be shipped as the Elbe was frozen. The opening prices for Dutch were, for superior 31s. 9d. and for ordinary 31s. 3d., f.o b., and by the middle of February the quotations had advanced to 35s. 3d. and 34s. 9d., the highest point of the year. From February on till early August there was practically a constant sagging of prices, and quotations fell to 24s. 3d. and 23s. 9d. At this date supplies in most Continental countries had been almost exhausted, and large purchases of white Javas, arriving in U.K. ports, were reshipped to the Continent to supply wants till new crop sugars became available in October.

Czecho sugars were frozen up till about the beginning of April, and then large tenders were made of sugars which should have been delivered in December, January, February, and March. When these became available the quotation for fine granulated was 30s. 3d., f.o.b., and the price movements thereafter were similar to those for Dutch. The supplies of Czechos, however, fell off much sooner, as they were able to find better markets in Eastern Europe, and from about the end of June till the middle of October there were practically no imports to the U K.

Large importations of American granulated were made, and the extremes of prices were 36s. 3d., c.i.f., in March and 23s. 6d. in early August. The drying up of supplies of Continental sugar, however, brought firmness, and from 26s. to 27s. was paid in September, but for only moderate quantities.

When new crop refined sugars came on the market early in October 25s. 6d. was the quotation for ready ordinary Dutch granulated, 23s. for October Czecho fine granulated, and 21s. for November. This great discount for forward deliveries, however, tempted few buyers, as there was a general fear of the expected huge increase in the beetroot crops. Buyers accordingly confined their attention to ready sugars that could be quickly shipped, and they were content to pay the premium, but restricting their purchases to cover actual requirements. The course of the market has been constantly downward, until at the close of the year the quotations are 18s. 3d. for fine, 17s. 9d. for ordinary Dutch, and 17s. 9d. for fine Czechos ready for shipment. More interest is, however, now being shown in forward deliveries, which command a small premium.

A year ago there was a feeling that trade was on the mend. Throughout the greater part of the year there was no improvement, indeed conditions seemed to grow worse, but within the last month or two conditions have been better, and once more a hopeful feeling prevails.

Publications Received.

(1) **Cane Sugar and its Manufacture.** H. C. Prinsen Geerligs, Ph.D. Second Revised Edition; xii + 342 pages, super-royal 8vo. (Norman Rodger, 2, St. Dunstan's Hill, London, E.C 3.) 1924. Price: 20s. net. (2) **De Fabricatie van Suiker uit Suikerriet.** H. C. Prinsen Geerligs. Fourth Edition. (J. H. de Bussy, Amsterdam.) 1924. (3) **De Rietsuikerindustrie in de verschillende Landen van Productie.** H. C. Prinsen Geerligs. Second Edition. (J. H. de Bussy, Amsterdam.) 1924.

(1) This first volume of the above three series of works by Dr. GEERLIGS is the new English edition of his well-known book, which has now been published. Excepting only the preliminary section on the chemistry of the sugars and the constituents of the sugar cane, it has been re-written, and contains a large amount of valuable new data. Especially have the sections on juice extraction, clarification, filtration, the preservation of sugar, and the exhaustion and nature of molasses, undergone radical changes, and have been brought more into line with modern views and their practical application. It is a standard work, one that should be read and re-read by all connected with the practical manufacture of sugar from the cane. (2) This volume is the Dutch edition of Dr. GEERLIGS' "Handboek," which, like the English edition, has been brought up to date. (3) The third book of this series is the latest Dutch edition of Dr. GEERLIGS' "World's Cane Sugar Industry," the information in which has now been revised. It is a most useful review of the historical, technical, economical and statistical aspects of the production of cane sugar in different countries. Both these Dutch works are published under the auspices of the Experiment Stations of the Java Sugar Industry.

Patents: Invention and Method. Harold E. Potts, M.Sc. (The Open Court Co., 149, Strand, London, W.C. 2.) 1924. (Cardboard covers.)

About two years ago we called attention to the author's "Patents and Chemical Research,"[1] and its great value to those concerned with the protection of the results of their invention, particularly chemical invention. This is another illuminating work on the same subject, but treating it differently in certain aspects. In the first two chapters, three essential points are discussed: firstly, the criterion of an invention, or whether it is possible to fix a standard by which an improvement may be judged an invention for letters patent; secondly, the definition of an invention, or how it can most clearly be defined in practice; and thirdly, the evolution of an invention, or the question of the formulation of a technique for dealing with specific industrial difficulties. Chapters three and four treat of language and style and of the problem of definition in patent law; whilst the remaining two are given to scientific method and the influence of patent law on the evolution of research. As in the case of Mr. Potts' previous work, information is given that must prove highly suggestive to most of those who are engaged in industrial invention. His remarks on questions such as: validity, claims, prediction in invention, language and style in patent law, and the problem of definition, are certainly of the greatest interest and illuminate many difficult points. Every research chemist should in our opinion be in possession of both of these books by Mr. POTTS, and he should study them.

The Scientists' Reference Book and Diary, 1925. Twenty-seventh Year of Issue. (James Woolley, Sons & Co., Ltd., Manchester). 1925. Price: 3s. 6d. nett.

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[1] *I.S.J.*, 1922, 261.

Review of Current Technical Literature.[1]

RESULTS OBTAINED WITH THE SEARBY SHREDDER IN NATAL. *E Wuthrich. Archief, 1924, 32, 4e deel, Verslagen, 2e Afl., 47-49.*

At one of the meetings of the last congress of sugar technologists in Java, Mr. WUTHRICH reported on results experienced by him with the Searby shredder in the milling of Uba cane in Natal when this apparatus was interposed between the crusher and the first unit of a four mill installation, 32 in. × 66 in., the normal capacity of which was about 13,000 piculs per day (793 long tons in 24 hours) His results are summarized below. The Searby was introduced in 1921, in which year and in the following one the maceration was increased to about 27 per cent. normal juice, whereas previously it had been 16 or 17 per cent.

Year	Cane Ground, Long Tons per Day	Normal Juice lost, per cent Fibre[2]	Increase in 1922 in Grinding Capacity, compared with the year in the first column, per cent	Increase in 1922 in Sugar Content of Juice Per cent Cane, compared with the year in the first column
1914	797	50·1	27	0·18
1915	792	45·9	27	0·18
1916	795	50·0	27	0·18
1918	842	53·5	20	0·18
1919	894	65·0	13	0·50
1920	884	59·8	14·5	0·35
1921	930	47·4	—	—
1922	1010	46·1	—	—

In this table 1917 is not reported, since the milling results were abnormally bad in that year ; and 1922 is taken as the year for comparison, rather than 1921, the first year's run during which conditions were hardly usual. It is of course difficult precisely to state what proportion of the increased capacity and extraction should be ascribed to the shredder or to the higher maceration. But it is safe to say that an increased maceration of 10 per cent with the old installation would not have given the figures reported in the above table. Such results obtained in the difficult milling of the Uba cane should direct attention in Java to this preparatory apparatus.

DATA ON THE FUEL (BAGASSE) CONSUMPTION IN JAVA FACTORIES DURING 1923 *Anon. Archief, 1924, 32, Mededeel. No. 42, 389-411*

Very numerous data are summarized in this article respecting the "fuel control" of 147 factories in Java,[3] the calculation and collation of these having been carried out by the Experiment Station on the same lines as the chemical control figures. Here, for example, are the average figures for the calories per kg. of cane in the three types of factories operating in that country :—

CALORIES PER K.G. OF CANE

Type of Factory, and their Number	Actually consumed.	In the Bagasse available	In the Extra Fuel necessary	In the Excess of Bagasse	In the Extra Fuel added	In the Fuel left over	In Cane Trash added.
Carbonatation (23)	592	565	31	4	46	19	24
,, ,,	592	564	32	4	48	20	23
Sulphitation (58)..	645	563	85	3	98	16	59
,, ,, ..	640	563	81	4	94	17	57
Defecation (66)....	620	578	47	5	59	17	32
,, ,, ..	604	568	41	5	53	17	28
All three types (147)	619	569	54	4	68	18	38
,, ,,	617	565	55	4	69	18	39

Where determined the water content of the bagasse was mostly below 45 per cent. (21 cases) ; and the calories per kg. of bagasse were 2200 for water contents between 41·8 and 44·8 per cent (21 cases), the lowest being 1832 for a water content of 51·5 per cent.; only 29 out of the 147 factories produced more bagasse than necessary for their fuel requirements; and, averaging the results of all the factories, the bagasse consumed was about nine per cent. short of the total fuel consumption. Of this nine per cent. of extra fuel, seven was made up of cane trash[1] and two per cent. of wood and molasses. Other figures were: steam production in kg. per sq. m. of heating surface per stoking hour, 14 to 16; and maceration below 20 in all but 11 factories.

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[1] This Review is copyright, and no part of it may be reproduced without permission — Editor, *I.S.J.*

[2] See *I.S.J.*, 1923, 140.

[3] *I.S.J.*, 1924, 444.

Appel's Process of Covering Massecuite in White Sugar Manufacture. *H. E. Lesueur. Archief, 1924, 32, 4e Verslagen, 4e Afl., 165-166.*

At one of the meetings of the Java Congress of sugar technologists (combined chemical and technical sections) a description was given of a method of covering in white sugar manufacture[2]: Whilst the massecuite is being brought into the centrifugals, it is covered with an indifferent liquid, viz., its own run-off syrup, this being added through a branch in the pressure line of the syrup pump, in which covering-syrup pipe a steam injector is placed. The purpose of the new method of working is to remove the cold mother-liquor from the crystal more rapidly and more completely by means of the same liquid at a higher temperature and a lower viscosity. Contrary to other systems, use is here made of a liquor which is as hot as possible, the actual covering taking place, not after spinning-out most of the mother-liquor, but during the charging of the machines. About 15-20 per cent of liquor per cent of the massecuite is the amount necessary. According to the speaker, the results of the new procedure are quite striking, its advantage being that.—The sugar is practically free from all mother-liquor, the purity of the clear syrup obtained is abnormally high, viz, about 90°, the quantity of circulating non-sugars is much smaller than in any method heretofore applied; the capacity of centrifugal and boiling stations is considerably increased; and the steam consumption at the after-workers is very much decreased (which means also a distinct gain in the amount of finished product). That portion of the run-off syrup which is raised to about 80-90°C. to serve as covering liquor will unavoidably dissolve a little crystal; but several experiments have shown that the amount of dissolution is very small, and anyway is less than if covering had been effected by water to give the same coloured sugar. Tests made with this process are said already to have marked it an improvement in the methods used in the white sugar boiling-house.

Rôle of Silica in Plant Growth. *D. R. Nanji and W. S. Shaw*[3] *Journal of the Society of Industry, 1924, 43, No. 51, 1—6 T*

In the course of a paper read before the Birmingham and Midland Section of the Society of Chemical Industry, the authors made the following remarks: Experience has taught agriculturists that silica-free plants are at a disadvantage when compared with the normal supply of silica. Plants grown in the presence of silica are able to withstand parasites and moulds to a greater degree. According to the more recent investigations, it has been established that silica is capable of increasing growth, and that such beneficial effect is particularly marked in the case of solids deficient in phosphorus Silica fulfils a very important function in plant metabolism which is not sufficiently clearly understood. There is reason for believing that such an understanding would prove of immense service to agriculturists in their attempts to combat plant pests and disease; and the great significance of the problem to the cotton and other such industries of economic importance which suffer annually heavy losses in their inability to cope with them may therefore be realized. Being specially interested in the physiology of the element silicon, and its relationships to phosphorus, studies have been commenced by the authors with such plant tissues as the straws of various types which are known to be highly siliceous. Silica is present in the plant as colloidal silicic acid, and not in the ionic state.

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[1] See also *I.S.J.*, 1923, 473. [2] Patent applied for. See *I S J.*, 1924, 102.

[3] Of the Department of Fermentation and Brewing, University of Birmingham.

Review of Current Technical Literature.

STUDY OF THE INCREASE OF COLOUR DURING THE EVAPORATION OF BEET JUICE IN EVAPORATORS OPERATING UNDER VACUUM AND UNDER PRESSURE. *Ales Linsbauer and J. Fišer. Zeitsch. Zuckerind. Czecho-Slov., 1924, 49, 25-29, 33-38, 41-47, 49-54, 57-63, 65-70.*

A series of observations were made during the 1923-24 campaign in different factories in Czecho-Slovakia in order to determine the increase of colour that occurs during the concentration of beet juice in vacuum effect apparatus as compared with that developing in so-called "pressure evaporation," as recently described[1] In each factory the test was run for three days; samples were taken every two hours from each of the vessels; and their degree of colour was determined by means of the Stammer instrument. In the main the colour of the concentrated syrups depended on that of the juice originally entering the evaporator, triple (Karlik) carbonatation with the use of 3 per cent. of lime giving the lightest coloured juices. Caramelization of sucrose is responsible for the development of colour only when the circulation of the juice in the different vessels of the multiple effect is insufficient, the actual cause of the formation of colour under proper working conditions being the condensation of nitrogenous organic compounds with sucrose or with reducing sugars to form a coloured body. In the table is summarized the average results obtained, the main point emerging from these being that the so-called "pressure evaporation" was found to increase the colour 59 per cent, whereas in one of the vacuum apparatus the increase was as much as 90 per cent. Contrary to what one might expect, the high boiling point of the juice and the high temperature of the heating steam had not a very harmful effect, provided that the circulation in the several vessels of the multiple effect is sufficient. Quadruples and quintuples having an inadequate circulation gave very bad results. Similarly, horizontal or vertical vessels having large heating surfaces, which cannot be wholly utilized, acted prejudicially on juice coloration, as did also incrustations, these lowering the transmission of the heat and in consequence the capacity of the apparatus

Type of Evaporator.	Increase of Colour, Per cent.
(1) Quintuple under vacuum, simple, consisting of 5 vertical Robert vessels	85
(2) Quintuple under vacuum, composed of 6 horizontal Wellner-Jelinek bodies, with steam "bleeding"	85
(3) Quadruple under vacuum, composed of 4 Wellner-Jelinek and 2 Robert bodies, also with steam "bleeding"..	50
(4) Quadruple under vacuum, composed of 4 Wellner-Jelinek and 4 Robert vessels, also with steam "bleeding"	90
(5) Quadruple under vacuum, composed of 2 Kestners, 1 Wellner-Jelinek, and 2 Robert vessels, also a pre-evaporator	57
(6) Triple *under pressure*, composed of 3 Vincik-Turek and 1 Robert vessels	59

EFFECT OF THE FILTER-PAPER ON THE POLARIZATION OF SUGAR PRODUCTS. *G. H. Hardin and F. W. Zerban. Industrial and Engineering Chemistry, 1924, 16, No. 11, 1175-1177.*

During routine work performed in the New York Sugar Trade Laboratory,[2] it was observed that when a raw sugar solution prepared for polarization was passed through a second paper the new reading was always distinctly higher than the previous one. This was not the result of the concentration of the solution by evaporation (as the funnel was covered with a watch-glass), but was due to a change brought about by the filter-paper. A series of experiments was arranged to investigate the effect of factors such as: the moisture content of the paper; the quality of the paper; the concentration of the sugar solution polarized; and lastly the time of contact. These tests clearly showed that, while perfectly dry paper causes a decided *increase* in the polarization, averaging about 0·12°V., on the other hand, paper with 14·5 per cent. of moisture gives a *decrease* of 0·12°V. Midway between the two there is a point at which the two effects balance one another In regard to concentration of the solution the changes with ½-normal and ¼-normal solutions are about half and quarter as much respectively as with a full normal. It was impossible to detect any effect which could be ascribed to the quality of the paper (the quantity always being approximately the same, viz., circles of 18 cm. diam). Time, however, is a factor of some importance, for whereas in a test the increase was about 0·03°V. for a rapidly filtering refined sugar station, on the other hand it was as high as 0·11°V. when the rate was slowed by restricting the outlet of a piece of rubber tube attached to the mouth of the funnel. Most writers advise the rejection of the first few c.c. of the filtrate, but they do this on the ground of its possible turbidity. With the object of overcoming the error due to the moisture of the paper, the International Commission for Uniform Methods of Sugar Analysis prescribed the use of dry filter-paper, which advice is probably followed by many careful analysts. But Messrs. HARDIN and ZERBAN here show that to avoid this error the practical procedure is not to use dry filter-paper (which increases the reading), but, while using ordinary air-dry filter-paper, to reject a good portion of the filtrate, not the first few c.c. only but at least 25 c.c. If this be done, then the closest possible approximation to the correct polarization will be obtained

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[1] I.S.J., 1924, 433

[2] A shorter abstract of this paper has already been published, I.S J., 1924, 313.

REFINING QUALITY OF PHILIPPINE RAW SUGARS *Herbert Walker.* *Committee Reports of the Second Annual Convention of the Philippine Sugar Association, 1924, 168.*

Until three or four years ago, Philippine sugars had a very good reputation with the refiners, but at the present time, owing either to marked improvement in Hawaiians or to a lowering of Philippines, the situation is reversed Philippine sugars are in disfavour and the principal objections raised by the refiners against such sugars are; Small, irregular grain; dirty colour in some cases hard to wash out, and slow filtration rate of affination liquor and melted sugar liquor, the first and last items being the most important. Small grained sugars require more water for washing in the centrifugals, causing an excessive amount of affination syrup, while the slow filtration rate retards the work of the whole refinery. Each factory in the P I. should send a composite sample of its sugar to a central authority every two weeks Samples should be tested there and comparative reports sent out every two weeks showing the percentage of different-sized grain in the sugar from each factory, and commenting on any improvements or retrogressions Ash determinations should be reported every six weeks. In view of the great importance of good "filtrability," it would be desirable also to report clarity tests on each sample and as many tests of actual filtration rates as can be handled by the laboratory force available. Since the filtrability of a sugar solution has been found to depend very largely on its clearness it may be possible eventually to establish a relationship between these two factors and dispense with routine filtration tests The Philippines have no refinery to fall back on in case of need. So long as refiners are short of sugar they may take it, whatever the quality, but in the event of an over-supply they will mark down the price on sugars which cause extra expense in refining. The toll system of refining, in which the refinery charges so much a ton for refining and marketing, has lately come into more general use. Under this basis the toll asked by the refiners would naturally be in proportion to the difficulty experienced in refining the sugar. The P. I. have a natural advantage over Hawaii that their cane juices contain less ash, being similar to Cuban in this respect, so there is no reason why they should not eventually be able to turn out as good a refining sugar as any country in the world.

MANUFACTURE AND USES OF REFINED DEXTROSE. *W. B. Newkirk.* *Industrial and Engineering Chemistry, 1924, 16, No. 11, 1173-1175.*

It may now be stated that the manufacture of pure dextrose is on a sound basis commercially and scientifically in America. Some technical details as to procedure are here given under the following headings[1]: Conversion and clarification and the preparation of liquors for crystallization; types of dextrose crystals and crystallization; and purging and finishing. In regard to the uses of dextrose, it is stated that it is not intended to be used as a substitute for cane sugar; but, owing to certain peculiarities which it possesses, it is in certain respects superior for certain manufacturing purposes. One of these is its tendency to form microscopically small crystals. Thus, fondants, creams, etc., can be produced which have the velvety feel and appearance so desired in these products. It also seems to affect the crystallization of cane sugar in the same way, and has thus become a necessity to the manufacturers producing fancy types of sweets, cakes, cold icings, milk chocolate, chewing gum, etc. It does not possess the sweetness of cane sugar; therefore, according to some of the larger fruit packers, it is the ideal sugar for preserving fruits of mild or delicate flavours, which are masked by the extreme sweetness of cane sugar when used in the amounts necessary. In the baking trade it is preferred as the yeast nutrient in a bread sponge. For medicinal purposes it is often in demand, especially in cases of acidosis, anæmia, and the earlier stages of Bright's disease, being the only sugar now commercially available which does not aggravate these conditions. Manufacturers of commercial pectin are quite large users of dextrose. Vinegar and wine manufacturers use it in the natural fermentation process, as it carries with it a maximum fermentability with no troublesome secondary flavours, which later have to be removed in vinegars, and which would spoil wine as it is consumed direct. Dye manufacturers are becoming large users of the product. And condensed milk manufacturers are also very desirous of using it.

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[1] See also *I.S.J.*, 1921, 575, 626.

ACTION OF ULTRA-VIOLET RADIATIONS OF SUCROSE SOLUTIONS *P. Beyersdorfer and W. Hess. Berichte, 1924, 57, 1708–1711;* through *J. Soc. Chem. Ind., 1924, 43, No. 48, B 957.*

Ultra-violet light, when its action is prolonged sufficiently, is said to decompose solutions of sucrose at 70 and 100°C., carbon monoxide, carbon dioxide, hydrogen, methane, organic acids, aldehydes, ketones, alcohols, and condensation products (caramel and dextrin) being produced, the action therefore being very similar to the thermal decomposition of this sugar. A crystal of sucrose becomes coated with a layer of caramel when exposed to ultra-violet light at 70°C.

NITROGENOUS NON-SUGARS OF THE BEET, AND THEIR BEHAVIOUR DURING MANUFACTURE. *W. Taegener. Centr. Zuckerind., 1924, 32, 852.* DUST EXPLOSIONS. *Berthold Block. Vereins-Zeitschrift, 1924, 37-64.* REPLY TO BLOCK'S REMARKS ON DUST EXPLOSIONS. *Paul Beyersdorfer. Vereins-Zeitschrift, 1924, 628-655.* LOW LIMIT OF CONCENTRATION FOR DUST EXPLOSIONS IN AIR. *L. J. Trostel and A. W. Frevert. Ibid., 1924, 656-671.* INDUSTRIAL FILTRATION (HELE-SHAW STREAM-LINE, VERTICAL AND ROTARY TYPES, KESTNER TYPE, CENTRIFUGAL SEPARATORS, GEE, STURGEON, AND VICKCEN TYPES). *S. G. Ure. Chemistry and Industry, 1924, 43, No 40, 975-983.* POWER ALCOHOL: COST OF POTATO AND GRAIN SPIRIT. *John Missenden. Chemical Trade Journal, 1924, No. 1950, 75, 388.* STUDIES ON CURLY-TOP DISEASE OF THE SUGAR BEET. *E. Carsner and C. F. Stahl. Journal of Agricultural Research, 1924, 28. No. 4, 297-320.* PHOTOSYNTHESIS. *E. C. C. Baly. Industrial and Engineering Chemistry, 1924, 16, No. 10, 1016-1018.* EXAMINATION OF PHOTOSYNTHETIC SUGARS BY THE METHYLATION METHOD. *J. C. Irvine and G V. Francis, Ibid, 1924, 16, No. 10, 1019-1020.* RECENT PROGRESS IN THE CHEMISTRY OF PECTIN AND ITS APPLICATIONS. *W. H. Dore. Ibid., 1924, 16, No 10, 1042-1044.* ELECTROLYTIC SODIUM HYDROSULPHITE. *R. H. McKee and N. E. Woldman. Colour Trades Journal, 1924, 15, 98.* DISPOSAL OF BEET FACTORY WASTES [BEET WASHING WATER, BATTERY WATER, LIME WASTE, AND STEFFEN'S WASTE] *Edward Bartow. Facts about Sugar, 1924, 119, No. 15, 346-347.* HEAT ECONOMY IN THE BEET SUGAR FACTORY. *Ales Linsbauer. Ibid., 1924, 19, No 14, 322-325; 1924, 19, No. 15, 352-354.*

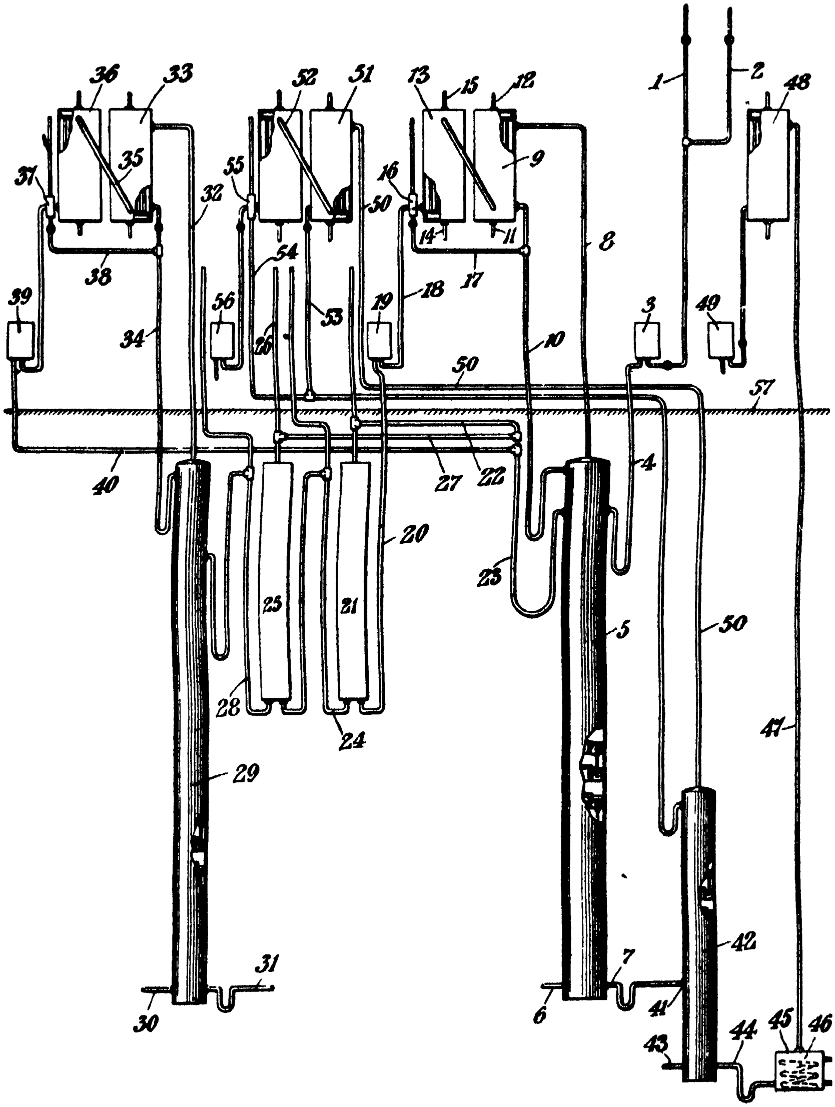
J. P. O.

Review of Recent Patents.[1]

UNITED STATES.

MANUFACTURE OF ABSOLUTE ALCOHOL FOR MOTOR FUEL PRODUCTION, ETC. *Arthur A. Backhaus* (assignor to the *U. S. Industrial Alcohol Company,* of West Virginia, U.S.A.). *1,508,435.* September 16th, 1924.

This is a process of dehydrating and purifying alcohol, the water being separated from the alcohol by the use of a third liquid which is miscible with the alcohol but substantially immiscible with water. This liquid is of such a character that, when the three constituents are present, vapours of the same are evolved by distillation containing a considerable percentage of water and the third liquid, so that all the water and the third



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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C 2 (price, 1s. each). *United States* · Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

liquid may be removed in this way from the residual constituent, which is the alcohol. The evolved vapours are comprised of a ternary mixture of the three constituents. This third liquid may be of any one of a number of different compounds, such, for example, as benzol, carbon tetrachloride, hexane, etc., but benzol is preferred. In the drawing is shown a valved inlet pipe *1* for feeding continuously into the apparatus an alcohol mixed with water; and which, by way of example, may feed to the system ethyl alcohol having a strength of 95 per cent. Leading into the pipe *1*, there is a valved supply pipe *2* for supplying initially the desired quantity of the third liquid, as, for example, benzol, and for supplying to the system additional amounts of benzol to replace the small quantities thereof which are lost by evaporation therefrom. The alcohol and benzol are fed to the system in proportions such that in the system, at any given time, there would be approximately equal parts by weight of 95 per cent alcohol and benzol, but preferably a slightly smaller quantity of the benzol than of the 95 per cent. alcohol. The valved pipe *1* leads into a tailbox *3* which is connected by a liquid-sealed pipe *4* to a dehydrating column *5*, which is constructed in any suitable manner, but which may have, for example, a plurality of plates the same as in the case of the usual alcohol rectifying column The column *5* has at the bottom an inlet *6* for steam for heating the column indirectly. Vapours are evolved from the column comprising approximately 74 per cent by weight of alcohol, 19 per cent. by weight of water, and 7 per cent. by weight of benzol, and substantially anhydrous alcohol flows from the liquid-sealed outlet pipe *7*. The evolved vapours pass out by means of a pipe *8* into a dephlegmator *9* which is connected by a liquid-sealed pipe *10* to the top plate of the column. The dephlegmator is cooled in the usual way with the aid of water inlet and outlet pipes *11* and *12* The incondensed vapours from the dephlegmator *9* pass through a pipe into a condenser *13*, the temperature in which is at approximately 64·9°C., said condenser being cooled by water passing through inlet and outlet pipes *14* and *15*, and the condensate therefrom enters a vented sight-glass *16* from which a portion of the condensate passes through a valved pipe *17* to the pipe *10* and thence to the top of the column *5*. The main portion of the condensate is conducted by a pipe *18* to a tail-box *19* and thence by a pipe *20* to a separating chamber *21*. The liquid received in the separating chamber immediately separates into two liquid phases forming layers, the upper layer of which is rich in benzol but poor in alcohol and water, while the lower layer is rich in alcohol and water but poor in benzol. The composition of the respective layers is approximately as follows:—The upper layer contains approximately 81 per cent. by weight of benzol, 4 per cent. by weight of water, and 15 per cent. by weight of alcohol, while the lower layer contains approximately 10 per cent. by weight of benzol, 35 per cent. by weight of water, and 55 per cent. by weight of alcohol. The upper layer is conveyed by a vented pipe *22* having a liquid-seal *23* back to the tower *5*, while the lower layer passes by a vented pipe *24* to a scrubber *25*. In order to remove the remainder of the benzol, water is introduced into the scrubber *25* by a pipe *26*, thus producing therein two layers of liquid, the upper layer of which contains the remainder of the benzol. The benzol is conducted from the scrubber by a vented pipe *27* to the liquid-seal *23* and thence to the tower *5*, while the lower layer is conveyed through a vented liquid-sealed pipe *28* to an alcohol rectifying column *29* having a steam inlet pipe *30* in the usual way for indirect heating and a liquid-sealed draw-off pipe *31* for water at the bottom of the column. The lower portion of the column *29* is maintained at a temperature of just above 100°C. The evolved alcohol vapours containing some water pass out of the top of the column through a pipe *32* to a dephlegmator *33*, constructed substantially the same as the dephlegmator *9*, and arranged to return the condensate therein to the top of the column *29* by a liquid-sealed pipe *34* The vapours from the dephlegmator *33* pass through a pipe *35*, the vapours in which are at a temperature of approximately 70°C., to a condenser *36* constructed the same as the condenser *13*. The condensate from the condenser *36*, which comprises approximately 95 per cent. alcohol, enters a vented sight-glass *37*, and a portion of the same passes back through a valved pipe *38* to the liquid-sealed pipe *34* and thence to the top of the column *29*, while the remainder thereof enters a tail-box *39* and is conveyed therefrom by a valved pipe *40* direct to the liquid-sealed pipe *23* and thence to the column *5*. The substantially anhydrous alcohol flowing from the bottom of the column *5* passes through the liquid sealed pipe *7* and an inlet *41* to a rectifying column *42* for finishing the treatment of the alcohol, said column being provided with a steam inlet pipe *43* for indirect heating and a liquid-sealed draw-off pipe *44* for the materials separated from the alcohol and which comprise any non-volatile constituent, as well as the xylol which may have been introduced as an impurity with the benzol, together with any remaining traces of benzol not separated from the alcohol in the column *5*. These separated materials pass into a flash-pot *45* where the vaporizable substances are driven off with the aid of a steam coil *46*, the vapours being conducted through a pipe *47* to a condenser *48*, the outlet from which leads to a tail-box *49*. The volatilized substantially-anhydrous alcohol passes out of the column *42* by a pipe *50* to a dephlegmator *51* and a condenser *52* constructed in the same manner as the dephlegmator *33* and condenser *36*, so that a portion of the condensate is returned to the column *42* through pipes *53* and *54*, while the main condensate passes out of the apparatus through a sight-glass *55* and a tail-box *56*. The apparatus is arranged so that the portions thereof requiring observation are located upon an operating floor *57*.

PROCESS OF MANUFACTURING SUGAR (IN WHICH PRECIPITATES ARE SEPARATED FROM THE JUICE IN A GRAVITATIONAL SEPARATOR OF THE DORR THICKENER TYPE).

Philip M. McHugh (assignor to *The Dorr Company*, of Delaware, U S.A.). *1,503,657*. August 5th, 1924.

Although involving method of separating solids from juice, which may be employed at any stage of the process where it is desired to carry out a separation of this character, the present invention is nevertheless particularly adopted to defecation, and especially where carbonatation has been employed, because of the great bulk of precipitate following this operation and the consequent difficulty of removing it expediously. The precipitate resulting is separated from the juice in a gravitational separator preferably of the Dorr "thickener" type. A stratum of mixed juice and solids is subjected to a combined sedimentation and decantation treatment, in the course of which substantially clear liquor is continuously withdrawn from the upper portion of the stratum, and solid material settling on the bottom of the stratum is continuously worked towards an appropriate solids discharge outlet and withdrawn from the stratum. A gravitational separator or thickener of the Dorr type suitable for the purposes of the invention is illustrated in Fig. 2 of the accompanying drawings. This separator consists generally of a cylindrical and relatively shallow tank *5* provided at its upper edge with a peripheral overflow launder *6* and having in its bottom a centrally disposed outlet *7* for the discharge of settled solids.

Fig. 2,

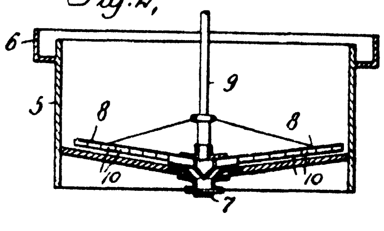


Fig. 3,

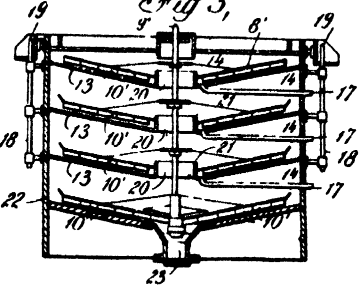
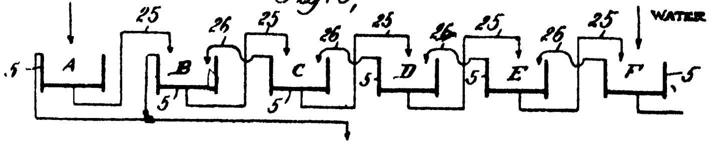


Fig. 5,



A revolving sludge collecting mechanism is operatively mounted within the tank *5* and comprises a vertically disposed shaft *9* rotatably mounted in appropriate overhead bearings, and provided with radially disposed arms *8* carrying a series of plows or scrapers *10* which are arranged to revolve in proximity to the bottom of the tank to move settled solid material from the periphery of the settling tank towards the central solids discharge outlet. A tray separator or thickener adapted to contain a plurality of superposed strata of mixed juice and solids is especially well adapted for the purposes of the invention. A separator of this type is illustrated in Fig. 3 of the drawings ; and comprises a cylindrical tank *22*, which, by a plurality of superposed desks or partitions *13*, is divided into a number of settling compartments *14* The mixed juice and solids is fed into the top compartment and is distributed to the lower compartments through central openings *20* in partitions *13* The openings *20* may be surrounded by upstanding collars *21* for the retention of the solids on the shelves or partitions *13* A revolving sludge collecting mechanism is operatively mounted within the tank *22* and comprises a vertically disposed shaft *9'*, carrying a plurality of sets of radially disposed arms *8'* arranged to revolve in proximity to the upper surface of the partitions *13* and the bottom of the tank. Each of the arms *8'* carries a series of plows or scrapers *10'* arranged to move settled solid material towards the centre of the partitions *13*, from whence the solids are discharged through pipes *17*, as well as through the outlet *23* in the bottom of the tank. The substantially clear supernatant liquor is decanted from each stratum by rising in headers *18* to a point of overflow *19* above the upper deck or partition Tray separators or thickeners of a type similar to that illustrated in Fig 3 but operating somewhat differently may be employed with advantage in carrying out the process of the invention Such an apparatus has been described in U.S. Patent *1,503,644*[1] The precipitate or sludge settling to the bottom of separator is worked towards the solids discharge outlet by the revolving sludge collecting mechanism. Lastly, if desired, it may be filtered, using preferably an apparatus of the vacuum type.

VACUUM PAN, CAPABLE OF BEING EVACUATED QUICKLY ON STARTING. *Paul A Bancel* (assignor to *Ingersoll-Rand Co.*, of Jersey City, U.S A.). *1,495,151*. May 27th, 1924. (One figure, three claims)

This invention relates to vacuum pan units, comprising a vacuum pan and a main condenser and vacuator, including an inter-cooler, but relates more particularly to devices for controlling the starting and subsequent operation of the vacuum pan. Its object is to enable a vacuum pan (especially for raw sugar syrup) to be evacuated quickly on starting, in order to bring the vacuum up as rapidly as possible to the desired degree By means of a relatively small connexion to the inter-cooler or inter-condenser of the unit, the starting is quickly effected and the main condenser is relieved of this additional comparatively heavy quantity of air. A vacuum pan of any suitable construction is connected to a main condenser which may be of the barometric type. An inter-cooler or inter-condenser is connected to the main condenser by a pipe, and primary augmenter jets supplied with steam from a suitable source (not shown) compress air and gases from the main condenser and discharge into the inter-cooler at a low vacuum. The inter-cooler is supplied with water by the pipe connected to the water supply pipe of the main condenser. A vacuum pump, or secondary jets, connected to the inter-cooler, forms the second stage of the evacuating apparatus. In accordance with this invention, the vacuum pan is connected to the inter-cooler by a by-pass pipe having an auxiliary controlling valve manipulated by an operator from the pan floor by means of a chain. A main controlling valve in the main connexion between the vacuum pan and the main condenser may also be manipulated independently by a chain. When it is desired to empty the vacuum pan, both valves are closed On starting the unit, the main valve remains closed at first, and the auxiliary controlling valve is first opened, connecting the vacuum pan directly with the inter-cooler by means of the by-pass pipe. The primary jets of the evacuating apparatus are not used at this stage, but the pan is evacuated quickly by the vacuum pump alone, or by the secondary jets, if used, or by both secondary jets and the vacuum pump. Then the auxiliary controlling valve is closed, and the primary jets are started in operation, and the main controlling valve is opened and the apparatus is continued in operation as long as desired.

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[1] See *I S.J.*, 1924, 670, for its description.

REVIVIFYING CARBONACEOUS FILTERING MEDIA (DECOLORIZING CARBON, ETC.). *Moriz Weinrich*, deceased ; *Dorothea J. E. Weinrich*, executrix. *1,502,076*. July 22nd, 1924. (No drawings ; one claim.)

Tanks are placed on a floor 15 to 20 feet above the filter-presses with frames of 1 to 1½ in thickness and so constructed that the cakes formed in the frames can be washed. As soon as all the frames have been filled, and the purified solution has run out, boiling water from a tank standing on the same floor as the supply or mixing tanks is turned on, and the cakes which have formed in the frames are first sweetened-off and then washed until the escaping water is colourless. When this point has been reached, the wash-water is turned off and the purification or revivification of the materials begins. For this purpose a closed tank is placed on the same floor as the other mentioned tanks, this tank containing boiling water to which sufficient ammonia is added to show a density of about 1° Baumé. This solution now follows the pure wash-water and by penetrating the cakes of the filtering materials it will dissolve and remove the remaining colour and impurities. The water running off will show considerable colour at first, which will gradually lighten, and as soon as this colour has disappeared altogether, the ammonia water is stopped and boiling water from the pure water tank is again turned on in order to remove the remaining ammonia water from the cakes. As soon as the ammonia is removed, the flow of pure water is stopped, and compressed air is turned through the cakes to remove a part of the water left in the cakes. Finally, the revivified carbon is discharged from the presses.

PRODUCTION OF BAGASSE FIBRE (FOR MAKING BOARDING). *John K. Shaw* (assignor to *C. F. Dahlberg*, of St. Paul, Minnesota, U.S A). *1,501,925*. July 22nd, 1924. (No drawings ; six claims.)

Prior processes for the treatment of bagasse fibre by boiling with soda have had as their object the production of pulp for paper making. In this process of making flexible and strong bagasse fibres provided with pith-like protuberances (capable of "felting" together) the process claimed involves : (*a*) the employment of a limited quantity of alkali, 2 to 10 per cent. by weight of the dry bagasse, (*b*) the retention by the fibres of the original pith with which they are associated ; (*c*) the production of strong, resilient and pliable fibres ; and (*d*) the precipitation of the original binding and encasing material from their alkali combinations upon the individual fibres to render the same water repellant.

CENTRIFUGAL MACHINES. *Tandy A. Bryson*, of Troy, N.Y. (assignor to *Tolhurst Machine Works*, of New York, U.S.A.). (*A*) *1,507,412*. September 2nd, 1924. (*B*) *1,507,413*. September 2nd, 1924.

(*A*) Claim 1 : A centrifugal machine including in combination a basket and supporting and rotating means therefor comprising a basket shaft, a flexible non-resilient support therefor, and a plurality of contracting movable friction members carrying the weight of the basket and shaft, and acting by such movement to dampen the gyratory movement of the shaft. (*B*) Claim 3 : A pillar for a centrifugal machine comprising a unit-casting having relatively thin angularly-disposed walls, uniting and reinforcing members there between, the pillar having its base at one side of the basket and curved upwardly over the basket, the upper end of the pillar serving as a support for the basket shaft.

FERMENTATION OF SUGAR (MOLASSES, ETC.) WITH THE PRODUCTION OF PROPANTRIOL. *Wilhelm Connstein and Karl Lüdecke*, of Wilmersdorf, near Berlin, Germany. *1,511,754*. November 14th, 1924.

Claim is made for "the process of manufacturing propantriol, consisting in adding alkaline sulphites and yeast to sugar, and then allowing the mixture to be fermented."

Patents.

UNITED KINGDOM.

Dissolving Sugar, and Filtering the Solution Produced. *F. B. Lomax*, of Chicago, U.S.A. *213,899* March 22nd, 1924; convention date, April 4th, 1923.

Syrups and other solutions are formed by circulating solvent through a mass of sugar or other solute and simultaneously agitating the solute or solvent. In the apparatus described, a receptacle contains liquid and has a diaphragm supporting the solute and comprising filtering material held between foraminated plates and locked by a split ring engaging a groove. A motor drives a propeller to agitate the materials and also drives a pump to draw the solvent through the filtering material and deliver it through pipe above the diaphragm or to a discharge pipe. Valves may be set to give a continuous discharge. The direction of circulation may be reversed and the pipe may discharge in the plane of the filter to thicken the suspension Forms of apparatus are also described having agitating means only and circulating means only

Rotary Dryer *H. A Gill* (*Ruggles-Coles Engineering Co.*, of New York, U S.A.). *221,974.* October 23rd, 1923.

Relates to rotary drying cylinders of the kind described in U. K. Specification *10,349* of 1910 and comprising a central gas flue and return flues arranged in the drying space, and consists in introducing air into the drum at the opposite end to that at which the gas and wet material are introduced, the air before contacting with the material being heated by passing through a chamber which connects the central flue with the return flues

Colloidal Nitrogenous Fertilizer[1] *I. Ishitani and Asahi Garasu Kabushike Kaisha*, of Tokio, Japan. *222,181.* June 21st, 1923.

Colloidal magnesium silicate is prepared for use as a forcing agent for manure, as described in Specification *218,401*[2] by mixing it with an animal or vegetable colloid, for example gum arabic, gloiopeltis glue, kadzura japonica, or gelatin, and drying the mixture to form a substantially reversible colloid

Boiler Scale Prevention and Removal. *J Sichert*, of Rogaska-Slatina, Yugoslavia. *204,027.* August 22nd, 1923; convention date, September 14th, 1922.

Resins soluble in hot water, such as olibanum or sandal-wood oil, are added to the boiler-water, or to the feed-water, at intervals of say 3–4 weeks, at the rate, e.g , of 20–40 grms per 1000 litres, according to the hardness of the water. Under the effect of temperature and pressure, a colloid-chemical action occurs, this causing the scale-forming constituents of the water, and also the scale already existing, to become removable as sludge.

Colloidal Arsenic Preparation for Pest Extermination or Suppression. *H. Vogel*, of Premnitz, Germany. *222,268.* August 4th, 1923.

It contains arsenic trisulphide in a colloidal form, and is prepared by precipitating the sulphide, for instance, by the addition of sulphuretted hydrogen, from a saturated solution of arsenious oxide containing a protective colloid. The reaction is carried out at low temperature (about 0° C) and preferably with agitation of the solution. A suitable protective colloid consists of a water extract of pine branches and pine needles concentrated until it contains 50 per cent of organic substance.

GERMANY.

Production of High-Grade Adhesive and Sirup from Desaccharified Beet Slices. *Kazimierz Smolenski*, of Warschau, Germany. *387,086.* February 23rd, 1923. Process for Separating the Precipitate obtained in the Treatment of Beet Factory Waste-Waters with Sulphurous Acid. *Reinzucker Ges. Patentverwertung m. b. H.*, of Berlin, Germany. *386,293.* April 14th, 1917.

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[1] See also *I.S.J.*, 1924, 618.

[2] Compare also U. K. Patent, 219,748; *I.S.J.*, 1924, 618.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending December 31st.		Twelve Months ending December 31st.	
	1923 Tons	1924. Tons.	1923. Tons.	1924. Tons.
Unrefined Sugars.				
Poland	2,344	27,134	8,258	65,043
Germany	....	1,836	1	3,841
Netherlands	....	....	14	210
France	....	. ..	....	....
Czecho-Slovakia		....	...	....
Java	8,047	36	249,232	89,276
Philippine Islands	....	....	....	....
Cuba	....	....	258,910	452,117
Dutch Guiana	....	....		....
Hayti and San Domingo	....	....	38,739	105,931
Mexico	....	. .	....	....
Peru	7,690	5,001	96,728	87,448
Brazil	2,278	294	87,970	22,622
Mauritius	44,136	10,487	222,980	125,932
British India	....	....	....	....
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	5,587	2,968	98,668	55,308
Other Countries	22,313	12,165	106,402	154,170
Total Raw Sugars	**92,395**	**59,922**	**1,167,903**	**1,161,899**
Refined Sugars.				
Germany	....	....	....	....
Netherlands	14,251	25,458	81,468	170,574
Belgium	10,378	8,841	35,650	48,686
France	....	60	235	1,898
Czecho-Slovakia	29,385	41,797	110,735	219,818
Java	....	....	....	....
United States of America	112	78	96,094	61,040
Canada	1	....	28,426	25,152
Other Countries	1,528	17,484	33,442	71,823
Total Refined Sugars	**55,654**	**93,719**	**386,050**	**598,991**
Molasses	8,768	12,516	133,666	170,568
Total Imports	**156,817**	**166,157**	**1,687,619**	**1,931,458**

EXPORTS.

British Refined Sugars.	Tons.	Tons.	Tons	Tons
Denmark	3	....	834	5,777
Netherlands	77	15	2,029	670
Irish Free State	5,974	3,720	41,199	50,423
Channel Islands	118	100	1,045	1,098
Canada	....	....	....	...
Other Countries	562	1,337	7,196	14,399
	6,734	5,172	52,303	72,366
Foreign & Colonial Sugars.				
Refined and Candy	472	134	15,268	5,670
Unrefined	3,721	97	25,413	11,199
Various Mixed in Bond	....	....	....	....
Molasses	178	64	3,078	2,905
Total Exports	**11,105**	**5,467**	**96,062**	**92,140**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1924. Tons.		1923. Tons.
Total Receipts, January 1st to December 31st	3,015,633	..	2,859,187
Deliveries ,, ,,	3,016,427	..	2,858,393
Meltings by Refiners ,, ,,	3,003,110	..	2,828,780
Exports of Refined ,, ,,	190,000	..	195,000
Importers' Stocks, December 31st	—	..	794
Total Stocks, December 31st	15,956	..	24,146
	1923.		1922.
Total Consumption for twelve months	4,780,684	..	5,092,758

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1921-1922, 1922-1923, AND 1923-1924.

(Tons of 2,240 lbs.)	1921-22. Tons.	1922-23 Tons	1923-24. Tons.
Exports	3,594,173	3,386,494	3,736,359
Stocks	223,397	86,266	145,422
	3,817,570	3,472,760	3,881,781
Local Consumption	125,000	108,000	115,000
Receipts at Ports to October 31st	3,942,570	3,580,760	3,996,781

Havana, October 31st, 1924.

J. GUMA.—L MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR TWELVE MONTHS ENDING DECEMBER 31ST, 1922, 1923, AND 1924.

IMPORTS.	1922 Tons	1923. Tons	1924 Tons
Refined	523,539	386,050	598,991
Raw	1,385,430	1,167,903	1,161,899
Molasses	122,771	133,666	170,568
	2,031,740	1,687,619	1,931,458

EXPORTS (Foreign)	1922. Tons	1923 Tons	1924 Tons
Refined	5,265	15,268	5,670
Raw	9,427	25,413	11,199
Molasses	3,505	3,078	2,905
	18,197	43,759	19,774

HOME CONSUMPTION.

	1922 Tons	1923. Tons.	1924 Tons
Refined	498,871	378 115	567,536
Refined (in Bond) in the United Kingdom	937,579	940,057	868,401
Raw	168,082	152,041	127,430
Total of Sugar	1,604,532	1,470,213	1,563,367
Molasses	10,237	10,082	7,140
Molasses, manufactured (in Bond) in United Kingdom	52,090	55,409	60,793
	1,666,859	1,535,704	1,631,300

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT DECEMBER 31ST, 1924.

	1922. Tons	1923. Tons.	1924. Tons
Refined in Bond	56,000	41,150	23,450
Foreign Refined	34,600	27,550	43,150
,, Unrefined	212,250	88,700	98,950
	302,850	157,400	165,550

United Kingdom Monthly Sugar Report.

Our last report was dated the 9th December, 1924.

The market throughout the remainder of last year had a sagging tendency and prices were gradually marked down, but after the holiday a steadier tone prevailed and prices for actual sugar were slightly advanced.

Business on the terminal market has been in fairly good volume, speculation still refuses to go into sugar at this level of prices and sentiment is still against the article. Over 13,000 tons were tendered in settlement of December contracts and this would have pressed more heavily on the market had it not been for one operator who took up about 10,000 tons. Dealings in December were fairly large and this month was traded in from 18s 3d. down to 16s. 9d., finally finishing at 17s. 6d. March sold from 17s. 10½d. to 17s. to 17s. 10½d. to 17s. 3d., May sold from 18s. to 17s. 3d. to 18s. to 17s. 4½d., and August from 18s. 1½d. to 17s. 3d. to 18s. 1½d. to 17s. 6d. New crop quotations were started on January 2nd, and business has been done in October/December from 18s. to 17s. 7½d., and December sold down to 17s. 6d. The latest prices are January 17s. 1½d., March 17s. 3d., May 17s. 4½d., August 17s. 6d., October/December 17s. 7½d.

Trading in actual sugar was dull and inactive up to the end of the year. Dealers, owing to their hand-to-mouth policy, had run their stocks down to a minimum and the advent of the New Year brought a general demand from the trade, especially as there were rumours of the Elbe navigation being closed in consequence of frost. Fine Granulated on the spot fell from 32s. 3d. to 30s. 6d.; from this point a large business was done which caused the price to advance to 31s. 9d, but the demand being filled up for the time being the price fell back again to 31s There is a great scarcity of lower-grade sugars on the spot and the lowest price recorded for Polish and Belgian Crystals was 30s. 1½d, but to-day the price is 30s. 9d. Kelham and Cantley have practically sold their output; at the lowest point Granulated from those factories sold at 30s. 6d. but to-day, however, they are asking 32s. A third factory—The Anglo-Scottish—whose first production this year will be about 3000 tons sold down to 31s. and to-day is asking 32s. 3d. White Javas have been nominal and a small business was done at 17s. 9d. c.i.f. U.K. for May/June shipment. Czecho Granulated ready sold from 19s. to 17s. 9d. and then as high as 18s. 4½d., but at the moment there are sellers at 18s. Dutch Granulated also sold from 19s to 17s. 9d. to 18s. 4½d., and to-day is offering at 18s. There is no demand for forward positions but these can be obtained at about 3d premium over ready Belgian Granulated and Crystals were at one time sold at 17s, but to-day the price is 17s. 6d. American Granulated came nearer parity and was offered at 19s. 9d. to 19s. c.i f., at which later price a small business was done. German sugars were not offering, as a higher parity was obtainable in their own country.

The British Refiners, who have passed through a very difficult period, are gradually coming back to more normal positions The German Government authorized the export of 100,000 tons of 88 per cent. Beet but so far their price is not attractive. 96 per cent. afloat and prompt sold from 15s. 3d. to 14s. 9d. c.i.f. Australian Preferential 96 per cent. sold at 16s. 6d. c.i.f., and 88 per cent. Beet sold down to 14s. 6d. c.i f. Some business has been done in Cubans for January shipment at 14s., and February/March down to 13s. 7½d.

The Refiners reduced their prices on December 10th by 6d. per cwt., on December 12th by 1s, and again on December 18th by a further 1s. On the 9th January they offered February at 6d. discount under their spot price, and March at 9d. discount. The latest quotations for spot are No. 1 Cubes 37s., London Granulated 34s. 10½d.

The demand for Refined in America fell off considerably and raws had a severe fall from 4⅜ to 3 cents c.i.f New York. A fair business in raws with the Refiners was put through as low as 2⅞ and $2\frac{13}{16}$ for prompt and January shipments. The Futures market relapsed and March is now quoted at 2·77 cents.

India has again been in the market and has bought considerable quantities of Javas and Mauritius.

Mr. F. O. LICHT has again advanced his estimate for the European Beet crops, which now stands at 7,175,000 metric tons.

With regard to Cuba Messrs. Guma & Mejer brought out their first estimate, viz., 4,724,214 tons, which is 100,000 tons over HIMELY's estimate.

21, Mincing Lane,
London, E.C. 3.
January 12th, 1925.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE INTERNATIONAL SUGAR JOURNAL.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 314. FEBRUARY, 1925. Vol. XXVII.

Notes and Comments.

A Beet Sugar Factory for the West of England.

The two groups that are chiefly responsible for the development of the beet sugar industry in this country, the Anglo-Scottish, and the Anglo-Dutch corporations, undertook as a start to furnish each three factories in approved districts. The Anglo-Scottish Beet Sugar Corporation has made itself responsible for Colwick (already in operation), Kidderminster, and Spalding. The Anglo-Dutch group have already got Cantley and Kelham on their hands, and are preparing to open factories at Ely and Ipswich next season. Their third venture is now announced to be at Yeovil in south Somerset. A company has been formed, called The Yeovil Beet Sugar Factory Limited and a site has been secured, of 70 acres adjoining the Great Western Railway and the River Yeo on the outskirts of that town. This factory which will have a capacity of 1200 tons of roots per day is not expected to be in full working order for the 1925-26 season; but three-year contracts for roots are being at once placed with farmers in the district, and their crops will be sent by rail to one or other of the Group's existing factories next Autumn till the Yeovil factory is working.

At a conference held in the Yeovil district last month, convened by the National Farmers' Union, to discuss the matter of supporting this new factory, a number of interesting points were elicited, according to the report in the local press.[1] It would appear that besides the Anglo-Dutch group another party was negotiating to erect a factory, and, were both persisted in, the result would have been two factories within a few miles of one another. The sense of the meeting was, however, against any such competition, since it was realized that one of the two factories must fail. It was also asserted that the Anglo-Dutch people were anxious to import for the Yeovil factory ready-made Dutch machinery (from certain factories in Holland not now in use) and had obtained from the Government a dispensation in this instance from employing the 75 per cent. British machinery, on condition that all their three factories were built this year instead of the third being left to a later date. It was urged by one speaker that although it was a laudable point of view to prefer British machinery for a British factory, yet it was desirable to get the benefit of foreign experience. There was not as far as he knew any organization in this country which could be regarded as experts in beet factory design.

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[1] *The Western Chronicle.*

It is very probable that the plans of the Anglo-Dutch group were too far advanced when the "75 per cent." clause was instituted by the Government, for the latter to insist on its application in the case of the three factories already promised Mr. SNOWDEN by this group; but if the clause is not to be a dead letter, there will be need to insist that dispensation shall be the exception and not the rule, even in cases where second hand machinery is alleged to be available. As regards expert organization, we believe it is the case that several firms of sugar machinery manufacturers in this country *are* taking steps to get the best design and co-operation from overseas beet sugar factory experts, including American ones. There is no doubt about the desirabilty of getting the advice from abroad, but in the present state of unemployment in the engineering trades in this country, there is far less excuse for procuring the machinery also from the same foreign quarter.

Sir Francis Watts.

We have pleasure in reprinting in the present number an appreciation of the work of SIR FRANCIS WATTS in connexion with the advancement of agriculture in the West Indies, as appearing in *Tropical Agriculture.* Its writer, Professor BOYD is, however, a newcomer, and cannot be expected to be thoroughly conversant with the position of affairs in those islands when Sir FRANCIS commenced his work in the eighties of last century and formed his plans for improvement. Yet we need merely add to the appreciation now printed one which we have already expressed,[1] namely, of the difficulties under which this pioneer work was started, coupled with the tenacious adherence to the ideals laid down, during so many years of formal acceptance and half-hearted attention, where encouragement might have been expected as a foregone conclusion. It would have been perfectly natural, in the circumstances, for Sir FRANCIS to have withdrawn his propaganda work and immersed himself in the laborious details of his official work; but this is not the way with pioneers. And when at length a more attentive ear was lent to his proposals, he had the advantage of being in a position at once to take advantage of the change and to present schemes of such obvious appositeness and value that they easily met all possible objections and went through almost without a hitch.

The United States Consumption in 1924.

The consumption of sugar in Continental United States for the year 1924, according to Messrs. Willett & Gray's annual review, was 4,854,479 tons,[2] expressed in terms of refined sugar. This consumption is only slightly larger than that of 1923, which was 4,780, 684 tons, the increase being 73,795 tons, or 1·544 per cent. Both the consumption of 1924 and 1923 were less than the record-breaking consumption of 1922, which was 5,092,758 tons. Indications last Autumn, as the year approached its end, were that the 1922 figure would be reached or perhaps slightly exceeded, but the unsettlement of the sugar markets made consumers refrain from buying, as prices were declining and quotations for future deliveries, that is during the early months of 1925, were considerably lower than spot prices; to these features is largely attributable the fact that the figure of 1922 was not attained.

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[1] *I.S.J.*, 1921, 242.

[2] The tons referred to here and below are all long tons of 2240 lbs.

On the other hand, however, the lower average prices throughout the year assisted in making the distribution as large as it was. The average price of Granulated was 7·471 cents net cash, while the price of 96° Centrifugals duty paid at New York was 5·964 cents, making the average difference between raws and refined 1·507 cents for the year, against the difference in 1923 which was 1·421 cents. The *per capita* consumption turned out to be 95·90 lbs., or almost exactly the same figure (95·63 lbs.) as that for the year 1923. The high point of *per capita* consumption was also reached in 1922 when it was 103·18 lbs. Exceeding the percentage of increase for 1924, which was 1·544 per cent., the average increase in the consumption for a period of 102 years is 5·252 per cent.

Corresponding in a general way to the increase in consumption through San Francisco, the consumption of Hawaiian sugars showed 10 per cent. increase over that of the previous year; Porto Rico followed suit, in proportion to its larger crop; and the same is true of the consumption of Philippine sugars. Taking it as a whole, however, the amount of domestic sugars, including sugars produced in Island possessions of the United States, at 1,943,485 tons was slightly less than the corresponding figure of 1923, which was 2,008,023 tons.

Cuba, however, with its largest crop on record, more than made up for the difference and Messrs. Willett & Gray's figures show a consumption of Cuban sugars to the extent of 2,824,155 tons, against 2,648, 223 tons in 1923. However, in addition to these two latter figures is the amount of Cuban sugars which was used by the Atlantic and Gulf Ports refiners in the production of Granulated sugar for export. A smaller amount of foreign full duty paying sugars entered into consumption, the figure for 1924 being 86,839 tons, against 124,438 tons last year.

As regards refining, it would appear that the American Sugar Refining Company with its five refineries barely held its own during 1924. Its distribution amounted to 1,002,488 tons of refined as compared with 1,017,694 tons in 1923, or 20 83 per cent. of the U.S. refined sugar consumption. All the other U.S. refiners' distribution grouped together, consisting of 15 concerns with 16 refineries located on the Atlantic, Gulf and Pacific seaboards, increased quite largely over that of the previous year, the figure being 3,018,204 tons against 2,714,104 tons. This is the largest stride ahead that this group of refiners has made in a number of years and, in fact, is the largest distribution they have ever attained. The same thing is true of their percentage of the refined sugar consumed, which figures are 62·72 per cent. this year against 58·46 per cent. in 1923.

British Sugar Machinery in Cuba.

Previous to the war British sugar machinery manufacturers enjoyed a fair share of the machinery trade of Cuba. On the outbreak of hostilities, however, that trade came to a standstill so far as Great Britain was concerned, and Cuban factory owners were obliged to get all the machinery they needed from the United States, thus enabling American manufacturers to get a strong hold on this business. For the period of the war they were alone in the field with no competitors.

With the war out of the way, British firms were once more in a position to seek for orders in Cuba, and a few of them sent representatives out again to that sugar centre. The efforts of these latter, we learn from a correspondent in Havana, have not been fruitless, and though so far orders going to British workshops have not been big, still the results of the fresh efforts cannot be described as discouraging. When one considers the character of the competition met with in Cuba from American manufacturers, it is very satisfactory to know that during 1924 British firms shipped a quantity of sugar machinery to that island, and so made their re-entry into the Cuban trade.

If a close watch is kept on this market and British engineering firms have their representatives on the spot keeping in touch with owners and engineers, there appears no reason why the shipments of British machinery should not be increased during 1925.

Artificial Pen Manure.

To all careful observers of the trend in present day sugar cane cultivation, several somewhat disturbing factors present themselves, working as they appear to do in a vicious circle. First of all it must be remembered that, since beet sugar seems likely soon to recover much of its lost ground, there is a prospect of a period of intensive competition setting in among the sugar cane countries; just at a time too when the internal conditions in most countries are not those best suited for increased production in the fields. There are two factors, indeed, which militate strongly against such increase, namely, the greater stringency in available labour, and the gradual depletion of the humus in the soil about which we hear so much nowadays—factors which may possibly have a considerable amount of connexion with one another. Labour difficulties are being countered by the introduction of mechanical cultivation wherever possible; and the result is very satisfactory in that the work is got through at a much greater rate, time being often a limiting factor where large areas are necessary for increased production. But it is a question whether this rapid cultivation is altogether ideal under conditions where no seasonal period of rest is enjoyed by the soil; and we have yet to see how the more useful members of the tropical soil flora will accommodate themselves to the new conditions. On them depends the formation of the humus which is so necessary for the production of sugar cane. The great invasion of temperate agriculture during recent years by labour-saving devices has to our mind placed the cultivation of the soil on a highly artificial basis; and it becomes a question how far this change is likely to be beneficial in the tropics where the natural conditions are so radically different. Added to this is the obvious fact that the cattle, on which the maintenance of humus in tropical soils has in the past so largely attended, are inevitably diminishing in numbers. Hence the vicious circle brought about by the interlocking of these economic and cultural factors.

In these circumstances, the impetus given to the activity of the humus-forming bacteria by the recent discoveries at Rothamsted appears to us as a ray of hope, and as such of extreme importance in sugar cane cultivation. And we make no apology for reproducing in full the article on the subject by Professor Hardy, referred to briefly in our last number. This article, it is true, is published in a journal widely distributed throughout the tropics, but there will be sugar cane planters who have not had their attention drawn to it, and it is for the benefit of these that we have reprinted it. We may add that, although the Rothamsted process has been patented, and we have an instinctive dislike of such action in agriculture, any gains thereby obtained are, we understand, not for personal profit but for the gradual building up of a fund for the endowment of agricultural research on these and similar lines.

Notes and Comments.

The Indian Sugar Industry.

On another page we give an account of the sugar trade in India during the last official year, from the pen of Mr. WYNNE SAYER, which we have abridged from a paper appearing in the *Indian Trade Journal.* Mr. SAYER, in summing up, foresees a period of severe competition in the near future which India must be prepared to face, and some of his remarks are well applicable *mutatis mutandis* to other sugar producing territories. "Every country," he says, "is trying to increase its production of sugar and unless consumption keeps pace with it an era of severe competition will set in and only those countries which can produce their sugar at a low cost will be able to hold their own. Both Cuba and Java will try their level best to retain the markets they have hitherto held and, in this severe competition and consequent low prices, those countries which run their industry in an inefficient manner will go to the wall unless aided by the imposition of heavy import duties. At the same time they must overhaul their entire method of production so as to eliminate all possible sources of waste. India must be prepared to face this struggle. Government can do its part by retaining the present import duty but the Indian sugar industry must also put its house in order and, as the stagnation of the industry in this country has been in the past due to the poor yield of cane in the growers' fields and inefficient management of factories, very energetic measures are required to improve the technical side of the factories and also to introduce improved varieties of cane with heavy tonnage into general cultivation so that a full supply of cane may be assured at a reasonable price. The Coimbatore canes, tested and introduced by the Sugar Bureau, have already shown the way, and it remains for the industry so to organize itself that vigorous measures are taken in hand for the further propagation and cultivation of these canes wherever factories are situated. It must again be emphasized that refining *gur* is not a line of advance, as with the low price of sugar it will not pay and the fact that out of 100 maunds of cane you can make on average 9 maunds of *gur* in North India, from which a refinery can, at the best, get slightly over 4½ maunds of sugar whereas a factory making sugar direct from these 100 maunds of cane would, at least, make 8 maunds of sugar, makes it clear that every well-conducted sugar factory put up in India which makes sugar direct from cane is a national gain inasmuch as it not only reduces the loss of sucrose in the cane, which at present takes place in crushing by the bullock-driven mill, but also provides employment for men in the factory and reduces the foreigners' bill for this commodity."

Recent Company Reports.

Among the usual list of company reports which are issued during the closing months of the year, the following relating to sugar companies may be placed on record.

Messrs. Tate & Lyle, Ltd., the sugar refiners, for the year ending September 30th last declared a dividend equal to 10·25 per cent. for the year, as compared with a distribution the previous year of 15 per cent. free of tax. The net profits amounted to £516,784, which compares with an average of £586,487 per annum for the previous three years.

The St. Madeleine Sugar Company, Ltd., of Trinidad, made a net profit in their last financial year of £19,603 after meeting debenture interest. The season was not as good as could be wished, but was much better than that of 1922-23, the tonnage of canes reaped having risen from 74,891 tons to 109,336 tons, one of the largest crops produced on the estate. The sugar obtained amounted to 17,203 tons, as compared with 13,739 tons. The yield of cane averaged 20·05 tons per acre, and the yield of sugar per acre 2·06 tons. This year's profit now reduces the debit balance to £58,042.

The report of the Trinidad Sugar Estates Ltd., covering its second year's operations to September, 1924, shows a net profit of £24,425, after meeting all charges. This compares with a net profit of £8043 for the period from 27th February, 1923 (when the new company was formed) to 30th September, 1923, and with an average profit of £28,486 for six years prior to the formation of the Company. From this profit the directors have authorized a dividend for the year of 25½ per cent. on the deferred shares and 8½ per cent. on the preferred shares, carrying forward £2381. This return is greater than was forecasted by the prospectus issued at the beginning of 1923, but with lower prices now ruling the current year may be less remunerative. Including bought canes, 41,427 tons of cane were dealt with, yielding 3611 tons of sugar, as against 3020 tons of sugar from 32,075 tons of cane in the previous season.

The Sena Sugar Estates, Ltd., made a net profit last season of £253,020 and declared a dividend of 15 per cent. (as compared with 2½ per cent.), put £30,000 to general reserve, £30,000 to depreciation reserve and carried forward £30,048. The output of sugar was 33,050 tons, which compared favourably with the previous season, while the price realized per ton f.o.b. Africa, averaged about £23. The new Luabo factory started grinding last August. It was designed to crush 50 tons an hour, but in practice has at times attained to 60 tons. Some minor delays inevitable in opening a new factory occurred, but the small crop of cane available was successfully crushed and yielded 4025 tons of sugar. The other factories, at Mopea, Caia, and Marromeu, all worked satisfactorily during 1924, and the total crop is expected to be approximately 39,000 tons. The high prices of 1923 have naturally not been maintained, but two-thirds of the recent crop had been sold by November at very satisfactory prices. The 1925 crop will, it is hoped, be considerably larger.

The last trading year of Sir J. L. Hulett & Sons, Ltd., of Natal showed a net profit of £151,496 ; a dividend of 8 per cent. plus a bonus of 5 per cent. was declared. The sugar crop for that season concerned was 56,087 tons, being the largest output the company has ever reached. The Government control of prices within the Union lapsed last June and since that time the company's prices have been entirely governed by the world's prices and the condition of the overseas markets. During the past year additions and alterations to plant and machinery were effected at the different factories, so as to improve the efficiency of the mills.

Leach's Argentine Estates, Ltd., made a profit for the year ending last March of £257,100, as compared with a loss the previous season of £130,900. The loss to date of £238,900 was consequently changed into a net profit of £17,300, which allowed for the payment of some arrears of preference shares.

Power Alcohol from Sugar Beet.

The British Power Alcohol Association (affiliated to the British Empire Producers' Organization) has presented a case to the Government by means of a deputation to the Minister of Agriculture, asking for the proposed subsidy of 19s. 6d. per cwt. on sugar produced from beet to be extended to the sugar content of beets used for making power alcohol.

The chief points made by the deputation were the agricultural importance of the beet crop and the very serious need of an alternative motor fuel to petrol. They pointed out that various Government Committees have warned the country of the need to produce power alcohol, particularly in the circumstances of the rapidly dwindling sources of petrol, together with growing consumption. The bulk of our motor fuel supplies comes from foreign sources, and the deputation strongly urged that it is essential for economic and strategic reasons that we should be free from this dangerous dependence.

It was pointed out that if the subsidy were granted, the comparative cheapness of an alcohol factory would prove a guarantee against monopolies being created, the aim of the British Power Alcohol Association being ultimately to encourage the establishment of centrals on a co-operative basis, in which the farmer supplying the beet shall have participation in the profits and a first claim on a portion of the product.

Foreign countries are entertaining large schemes for the development of power alcohol, and even the United States, who have the largest supplies of petrol, have initiated extensive power alcohol enterprises at Baltimore and other places.

Leading experts who have examined this question on behalf of the British Power Alcohol Association are satisfied that at a cost for beet which could make the sugar industry just pay its way if present prices for sugar were maintained, power alcohol could compete easily with petrol, even if the average post-war petrol price were not to be exceeded, a supposition which seems unlikely in view of the concensus of opinion among the authorities upon petrol supply that demand is increasing while supplies are definitely decreasing.

The importance of having an independent source of alcohol in this country to assist in competing with existing foreign sources of motor fuel, and the benefit to agriculture that would result, are obvious. The only question that arises is whether there is enough acreage available in this country for growing beets for alcohol over and above the requirements of the home sugar industry. So long as the consumption of sugar in this country exceeds very considerably the output of what some agricultural authorities think is the biggest area under sugar beets that can be spared from other crops, there will be every need for growers of beets to turn them into sugar rather than alcohol. What roots are devoted to alcohol can only be at the expense of sugar production.

But this apart, there seems no reason why such an alcohol industry should not succeed. The alcohol factory, unlike the sugar usine, can work practically all the year round, for apart from using beetroot as raw material, there would be the raw molasses from the sugar factories, and cane molasses also could be imported during the inter-season, while other suitable saccharine raw material might be available.

The Consumption of Sugar in Europe.

(*After Willett & Gray.*)

The following Table shows the consumption of sugar in the principal countries of Europe for a series of years, including the last pre-war year.

	1923-24 Tons.	1922-23 Tons.	1921-22 Tons	1920-21 Tons.	1919-20 Tons.	1913-14 Tons
United Kingdom[1]	1,470,347	1,604,532	1,257,044	924,762	1,297,890	1,614,981
France	796,008	817,309	767,409	559,113	823,660	716,849
Belgium	153,527	163,205	158,150	128,951	135,815	113,619
Holland	223,130	230,302	235,448	208,633	205,448	99,795
Germany	910,215	1,481,488	1,435,890	1,164,727	920,939	1,455,258
Czecho-Slovakia[2]	361,754	351,959	309,376	318,339	342,049	519,559
Italy	312,286	294,250	314,152	135,768	247,248	194,100
Spain	198,984	165,000	175,962	194,909	155,820	129,443
Roumania	90,000	51,000	57,111	48,274	20,999	48,339

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[1] U K. figures are for calendar years 1914-1923.

[2] Statistics for 1914-15 to 1916-17 are for the Austro-Hungarian Monarchy.

Fifty Years Ago.

From the "Sugar Cane," February, 1875.

A further comment was made on Russell's maceration process, allusion to which has been made on two occasions lately,[1] these remarks making curious reading nowadays:—"The experiments in maceration carried on at Belair during the last fortnight have had a great effect on public opinion. They have demonstrated that good sugar can be made from the juice obtained by maceration, and that from the first and second juices, mixed, good sugar can also be obtained. The quantity of sugar got from the second expression at Belair is fully equal to 25 per cent. of that obtained from first crushing. We have not before us yet sufficient data to guide us in an estimate of the cost of the sugar obtainable from maceration, but the opinion is becoming general that maceration will pay. Of course extravagant anticipations are being indulged in by optimists, who imagine that maceration will prove to them a veritable *El Dorado*. Without indulging in any such fallacious hopes, we may point out the very important influence maceration is likely to have upon the fortunes of the colony should it prove in practice the success which the experiments at Belair presage. We have received . . . . . a sample of maceration sugar made to-day. . . . . This sample is quite equal to, if not superior, in quality to the sugar made from first crushing; but it has a better 'bloom,' and is of the kind to command a good price in the sugar market."

Other technical matter in this issue of our predecessor consisted of a controversy between several Greenock refinery chemists on the discovery of the presence of ferrous sulphide in animal charcoal, this occupying 12 pages. R. **Spier** pointed out that Frazer Smith's observation of the presence of ferrous sulphide was not new. **Frazer Smith** replied that actually the observation was an old one (**Muspratt** having announced it in his well-known article on bone-black); but that his claim to credit lay in the fact that he was the first to produce analytical figures proving its existence. Then **Martin Murphy** concluded the discussion by showing that there was no "discovery" at all, the fact having been known well enough to certain well-known chemists (as Dr. **Wallace**, and **Patterson** and **Ogilvie**), who, however, were in the habit nevertheless of reporting all the sulphide as calcium sulphide. Analyses made in 1871 proving this point were published.

There was a note on the use of bagasse for paper manufacture, which ran as follows:—"Paper manufactured from the refuse of the sugar cane is reported from Guadaloupe. The paper is said to be of excellent quality, thick, fine-grained, and with a particularly fine surface . . . . ."

It is of some interest to scan the advertisement pages in this early issue of the *Sugar Cane*, and among the firms who at that time supported the publication, and whose names or those of their successors still figure therein, were: John Fowler & Co., of Leeds (Steam Cultivation Machinery); George Fletcher & Co., of London and Derby (Sugar Machinery); Manlove, Alliott & Co., of Nottingham and Rouen (the same); and J. Bailey & Co., of Salford, Manchester (Pumps, Injectors, Safety Valves, etc.).

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[1] *I.S.J.*, 1925, 7; 1924, 630.

Sugar Cane Cultivation in Louisiana.

During the latter part of the past year occasion has been taken in this Journal to refer to the problems which appear to be exercising those in charge of the Louisiana sugar industry at the present time, whether concerning climate, labour, drainage, rotations or pests and diseases[1]; and earlier in the year certain generalizations were indulged in as to the economic factors, favourable or otherwise, which govern production in different countries, with Louisiana occupying the title rôle.[2] The great amount of attention now being paid to the economic stability and future prospects of the sugar industry in the United States has led to a careful analysis, by a strong committee, of its environmental conditions and especially, in view of labour stringency, of the current agricultural practices—the result of many years of accumulated experience and scientific study—dealing primarily with the crop of the year 1922. This Committee included members of the United States Bureau of Plant Industry, the Bureau of Agricultural Economics, the Louisiana Agricultural College, the Bureau of Entomology and that of Home Economics, and its conclusions may well be regarded as authoritative.

The report of this committee is issued as a portion of the year book of the U.S. Department of Agriculture for 1923. It deals with sugar production in the United States and, because of the complexity of the subject, confines its attention to the continental section. The Louisiana cane sugar crop and the northern beet crop are dealt with separately; and short references are made to the attempt at producing sugar in Florida, syrups from cane in the Gulf States and sorghum further north, as well as maple sugar and syrup. It may be taken for granted that the description of the Louisiana sugar industry, covering some 40 pages, is the last word on the subject and worthy of very careful attention. And it is to the economic study of cane cultivation that the committee chiefly devotes itself, all the phases of cultivation being considered in turn and set out in terms of crews employed, number of acres worked per day, man- and mule-days required per acre cultivated, and so on. Although the sugar industry is dealt with from all points of view, the major portion of the study thus deals with the costs of production in the field. The various operations themselves are often very briefly referred to, and a little difficulty is sometimes experienced in finding out exactly what is done; but a fairly good general idea of the current agricultural practices may be drawn by a perusal of the multitudinous headings of expenditure. The object of this paper is to reflect the committee's opinion as to the environmental conditions in Louisiana, the difficulties in which the industry finds itself placed, and its future prospects.

The sugar cane is a tropical plant, which connotes certain climatic requirements for optimum growth. These are briefly high temperature, ample sunshine and a continuous supply of water during the year round. The best growing conditions are such as obtain in hot humid climates, where torrential downpours quickly give place to periods of brilliant sunshine. It is a perennial tufted grass which has adapted itself to the usual seasonal changes of the year. Its individual shoots require one year to complete their growth; and end in a feathery plume of flowers at a certain period, more or less definite for each locality. As no further growth can be expected from the shoots that have flowered, fresh ones appear, chiefly at the base, and form the canes for the next year, which in their turn mature and form flowers at the appointed time. These shoots always contain sugar instead of the more usual starch in their storage cells; but this is of two kinds, crystallizable and non-crystallizable which vary greatly in their relative proportions during growth. The amount of the latter is considerable during the earlier stages, but towards the end the former greatly preponderates, and yields the juice needed for the extraction of commercial sugar. The cane is called, technically, mature or ripe when this stage is reached, and the juice is called rich or pure; but this condition does not accurately coincide with the time of flowering, and full ripeness generally occurs some little time after the flowering period has ceased in a crop. While warm, humid weather is desirable throughout the growing period, cooler and drier air are more favourable to the process of ripening.

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[1] *I.S.J.*, 1924, 581, 653-655.

[2] *Ibid.*, p. 123.

The question as to how these conditions are met in the Louisiana sugar belt is impartially summarized. As it is well outside the tropics, the warm period is insufficient for the full development of the cane, although this is to a certain extent got over by the introduction of early maturing varieties, namely, the local Purple and Ribbon canes and a Demerara seedling, D 74. Even thus the canes reaped are unripe and flowering does not occur. Frosts are met with during the winter months in the southern United States, and this throws the sugar belt into the extreme south, where they are less frequent or severe, and it is only in the southern half of Louisana that sugar can be economically obtained from the crop. It is true that climatic conditions are perhaps even more suitable in the south of Florida, but at present sugar making there can only be regarded as under experimental conditions, because of soil and drainage difficulties. In the sugar belt of Louisiana the frost free period extends to 250 days in the year. During the somewhat short possible growing period thus provided, a well distributed rainfall gives the necessary humidity, and ample sunshine is available, simulating conditions in the tropics. But it is obvious that any period of drought, which may occur in any crop solely dependent on rainfall, or even a succession of cloudy days although accompanied by rain, will check growth and decrease the crop. The cooling of the air and diminution of the rain in the autumn, while limiting the period of active growth, assist in the premature ripening of the canes. The main drawback in the United States cane sugar industry is thus seen to be in the climatic conditions.

On the other hand, in the locality marked out above, the soil appears to be exactly suited to the optimum growth of the sugar cane; it is suggested that nowhere else does this plant grow more rapidly, although this rapidity may be rivalled in northern India where somewhat similar conditions prevail. The cane is chiefly grown on the Sharkey clay, but there are also a succession of clays of other series, usually silty and sometimes even sandy, where the crop succeeds over smaller areas. All of these soils are rich, and what is perhaps even more important highly retentive of moisture. It has been noted that the great preponderance of short crops which are on record have occurred as a result of a temporary period of drought during the growing season, but irrigation does not appear to have been introduced. This is all the more surprising in that it is considered that nowhere else could it be more cheaply and effectively brought into action than in the Louisiana sugar belt. It is pointed out that wherever irrigation has been introduced it has proved economically sound; and this not only where the normal water requirements of the cane are wanting, as in arid tracts, but also where sufficient rain falls, the increased yields more than paying for the heavy additional expense. But any such work would have to go hand-in-hand with a very thorough system of drainage. Owing to the retentive character of the soil, downward percolation of superfluous water proceeds at a very slow rate, and it is at present considered that it is almost impossible to overdrain the land. The digging of drains is an important item in the preparation for planting and cultivation, but the keeping of the drains in order appears to be less carefully attended to than it should be. The system used is one of open ditches, and all that is required is to enable the occasional torrential downpours to flow off rapidly. While the sugar cane will survive a flow of water over the surface for quite a time without injury, it is peculiarly sensitive to any stagnant water, which quickly destroys the crop. Tile drainage is obviously indicated; but, on trial, the flat character of the land and the silty nature of the soil prevent their being used, as they soon become clogged and ineffective.

Because of the shortness of the season, it is obvious that it is advisable to allow the canes to remain in the ground as long as possible. Formerly this practice was attended by a certain amount of risk from sudden frosts, and great losses were sometimes experienced. But it is stated that, with the excellent system now in vogue of temperature forecasts, such losses have greatly diminished in recent years. It is, however, inevitable that another complication is added to the industry because of this practice. In the tropics the cropping season may be spun out for several months, but it must be done very quickly in Louisiana. As soon as a forecast is issued indicating a fall of temperature to 26° or 27°F., all hands are turned to cutting the canes and hurrying them to the mills. But these are not capable of dealing with the mass of canes rushed in, and the surplus has to be bedded in the ground or as it is termed "windrowed." This additional item of expense is, however, apparently not so great as might be expected, and the storage of the canes temporarily in this manner does not appear to decrease their sucrose contents.

But a great deal of other work has to be got through at this time of the year; and this has led to such considerable congestion that the committee remarks that with the available labour it is not possible to accomplish everything to the best advantage. In Java and Formosa the seed required for each crop is obtained from special nurseries; and this system of dissociating planting from factory work has such obvious advantages that the idea is being widely canvassed in yet other countries. It is, however, not possible to separate the two in Louisiana, although it would appear to be of special value, and even the preparation of the land is not free from interference because of the shortage of labour. There are two seasons for planting the cane in Louisiana, namely, in autumn commencing about October 15th, and in spring in January, February or March, and even sometimes in April. The preparation of the land is practically the same in both cases, excepting that for spring planting it is more expensive in that the seed cane has to be windrowed to save it from the frost.

The following appears to be the programme during the autumn, the period of heaviest work in the fields. The preparation of the land for fall planting commences in the latter part of August; but it is interrupted in the middle of the next month when the corn, hay and other feed crops must be reaped, this occupying the rest of September. It is then resumed, and planting commences about October 15th, and continues until grinding begins. No date is given for this, and it suggests itself that the date depends to a certain extent on the weather forecasts. Presumably most of the planting is done before a forecast indicates the possibility of a frost; for then every man and mule is diverted to rushing the canes to the mills and protecting the remainder by windrowing. But we note that in many cases a good deal of autumn planting cannot be completed to schedule and has thus to be postponed to the spring. The preparation of the seed cane for spring planting has, of course, to be attended to; it must be cut and laid, and windrowed as well. There seem to be conflicting views as to which time for planting is really the best.

A wet winter will cause much damage to the autumn-sown crop by rot, and if the soil becomes dry many young plants will wither and dry up, and the same effects are produced on the windrowed seed. But the sponsors for spring planting point out that they have a much better chance of obtaining a full stand of canes for the crop, in that they can select the seed which has come through safely—which suggests that a good deal of waste occurs in any case, in windrowing more seed cane than may be actually required. Fall planting is apparently done where possible, as the ground is wetter and rains are more frequent in the spring. These facts will suffice to justify the conclusions arrived at by the Committee that the work suffers from the rush and uncertainty at the end of the season; and the scarcity of labour being in the main responsible for this state of affairs, we have a new adverse factor introduced of almost equal importance to the climatic one already mentioned.

A three-year rotation is usually practised in the cane fields; corn (maize) and cowpeas, plant cane, stubble cane (ratoons). Second ratoons appear to be sometimes indulged in, but the rapidly decreasing yields rarely justify this. The corn is planted early in the spring, and peas are sown in between the rows at the last cultivation. The corn is not a profitable crop, because it is planted at the usual cane row distance (5-6 ft.), and has little labour devoted to it, as that is required for the sugar cane during the growing period. But, besides giving a certain quantity of grain and some fodder for the mules during autumn and winter, it is useful in preparing the seed bed for the peas and in supporting them in their growth. The object of the peas is, of course, to replenish the soil with humus and nitrogen, taken out of the soil by the two crops of cane. It is preferable to bury the whole in preparing the land for cane, but not infrequently a certain quantity of the vines is kept for mixing with the corn stalks as fodder If it is considered that the nitrogen requirements are not met by this procedure, the deficiency is made good by adding cotton seed meal as a manure. Where artificials are applied, the quantity is 400-600 lbs. for plant canes and somewhat more for ratoons. In plant canes either the whole of the artificial manure is applied in the furrow at planting time, or part only is given then, the rest being scattered along the sides of the young plants after the first cultivation. The ratoons are usually manured immediately after the first and second off barring, when the soil is thrown from the stools to the middle of the rows, this soil being returned later on and the middles opened with a double mould board plough.

In summarizing the outlook for the future of the cane industry in the United States, the committee notes that the cane sugar portion, while limited climatically, is not necessarily so as regards area; in fact, is capable of considerable expansion even with the present varieties of cane. But this expansion in area does not exhaust the possibilities, in that improved methods of cultivation and the production of better kinds of cane by breeding work have not been fully investigated. But, after all, the limiting factors would appear to be rather economic than agronomic, labour supply, market price of sugar, and assurance of protection, all having important influence. The problem of securing and holding an adequate supply of labour on cane plantations must be solved before any increase in production can be expected; and the solution may lie in small farm production by owners rather than by day labour under supervision. No sugar producing country is without its own peculiar problems, which although very different from those in the United States are just as difficult to solve, and the most successful ones in the future will be those which give the greatest attention to the systematic and intelligent study of the factors limiting production.

The text of the report, as already stated, is interspersed with a series of tables giving the amount of man and mule labour required for the various agricultural operations. Where mules are employed, the usual team is two under the guidance of one man, although some of the lighter work is done by one mule ; on the other hand rolling requires three mules and hauling the harvest of canes four mules to one man. Quite a number of operations are perforce done by hand, such as cutting, loading, preparing the seed, laying it in the planting furrow or for windrowing, shovelling the drains after they have been ploughed, and so on. It is also to be noted that, under "men," are included women, and grown boys and girls, these latter all receiving approximately the same wage ; no distinction is made between these four classes of labour in the tables and all are included in the general term man-days. Each operation has a line to itself, on which various details are entered under headings, such as crew of men and mules, number of acres covered in a day, number of days or fraction of a day required to work over one acre, and so on. At the foot of each table, which deals with a complete set of operations, such as preparing the land for cane, fall planting, stubble cultivation, etc., a summary is made of the total amount of labour required for the purpose, later on, of estimating the cost incurred in cultivating the fields in general, whether by the acre or for ton of canes produced.

These details it is obviously impossible to reproduce without reprinting the tables, but it may be of interest to give lists of the operations performed, with the total labour force required for different classes of work.

Preparing the land for planting needs the following operations : Cap off, mould (four times), harrow, plough drains, shovel drains ; and the total number of man-days per acre is 1·04 with 1·89 mule-days for clay soil, and slightly less for sandy soil.

Fall planting requires 11·21 man-days and 6·80 mule-days, distributed over the following : Strip and cut, load and haul, open the rows, lay and whack, cover, roll, plough and shovel drains, and water boy. The same items are recorded for *spring planting* with the exception of rolling ; but windrowing has to be included, thus : in the fall, cut cane and lay in bed rows, cover with plough, hoe, plough and shovel drains ; and in the spring, remove soil cover, pull canes off with monkey, shuck out, load and haul. For planting one acre 15·69 man-days and 9·50 mule-days are necessary.

Cultivation of spring or fall canes : Bar off, plough drains, shovel drains, hoe and scrape, harrow middles, re-bar off, shovel drains, cultivate with disc, cultivate with shovel, shovel drains, plough middles, plug drains (contract work at $1 per acre) ; the total working out at 12·04 man-days and 5·72 mule-days. *Cultivation of stubble canes* is just the same as in planted canes, with the following additions : Shave stubble, dig stubble, shovel drains ; bringing up the total work to 12·39 man-days and 6·25 mule-days per acre. *Manuring labour* varies from 0·27 to 0·45 man-days, and 0·30 to 0·55 mule-days, according as the manure is distributed all at once or in two applications, and according as 400 or 600 lbs. of manure are given.

Harvesting an acre takes up 10·97 man-days and 5·32 mule-days. Reaping a ton of canes varies with the yield ; for a 12-ton crop 0·90 man-days and 0·43 mule-days, and for a 17-ton crop 0·65 man-days and 0·31 mule-days.

The rates paid for labour are given in a table for the seven years, 1916 to 1922. During the grinding season all labour receives an increase in wages of 25 to 75 per cent. above what is given for the rest of the year. In 1916 the daily wage was, for men, $0.80, women $0.60 and for drivers $0.90, increasing during the rush period to $1.25, $1.00 and $1.50 respectively. During the boom years (1918 to 1920) these rates increased very considerably, sometimes to double of those given above, but by 1922 they had fallen again, in the grinding season to the former level, but for the rest of the year only to $1.00, $0.80, $1.25 respectively.

The man-days of labour spent in field operations for the production of an acre of sugar cane during 1922 are summarized in the following table :—

	Preparing Land.	Storing and Transporting Seed.	Planting.	Cultivating.	Manuring	Harvesting.	Total Man-days.
Fall planted cane	0·95	4·80	2 81	12·04	0·45	10·97	32·02
Spring planted cane	0·95	10·10	3·17	12·04	0·45	10·97	37·68
Stubble cane	—	—	—	12 39	0·45	10 97	23 81

A diagram illustrates the cost of producing an acre of cane (unmanured) in Louisiana during 1922 (leaving out rent of land), and bringing it to the point of acceptance by the factory ; labour in the factory is thus not included. Man-days are averaged at $1.25 and mule-days at $0.80. From this diagram it appears that fall planted cane costs about $85 per acre, spring planted nearly $100, and stubble $46, with weighted average slightly under $70. This cost is considered high as compared with that of other field crops in Louisiana ; and is put down to the relatively large amount of manual labour involved, together with the high cost of seed cane in the United States. At the usual rates of planting it requires 4 tons of seed cane per acre for fall planting and approximately 5 tons for spring planting. To keep half the acreage in plant cane each year, consumes therefore a considerable portion of the crop. About 15 per cent. of the total yield of cane is used for seed each year.

The total cost of manual labour necessary to produce the cane and deliver it to the factory is the largest single item of expense, and during 1922 reached 42 to 47 per cent. for plant cane and 53 to 58 per cent. for stubble. In a plantation with one quarter each of fall and spring planting and one-half stubble, the manual labour thus accounts for 48 to 52 per cent. of the cost. The cost of growing and harvesting a ton of cane, exclusive of overhead charges and interest on investment in land, was calculated for about 4000 acres selected from individual plantations as typical of the 1922 crop ; and came to $5.32 for fall planting, $6.18 for spring planting, and $4.42 for stubble, with a weighted average of $5.08. These are some of the figures extracted from the various data which have been brought together in this report ; and should present the means of forming some idea as to costings, as compared with those in Louisiana, in other parts of the world. As the committee say, with these heavy labour charges and the great outlays on the factories, railways and communications generally, cane sugar manufacture in the United States must be operated with the highest possible efficiency, both in the field administration and factory methods. But it may also be suggested that, but for a large measure of protection, open competition would involve the industry in considerable difficulties. C. A. B.

An interesting application of colour measurement was mentioned by Dr. **LOUIS C. MARTIN**[1] in a recent Cantor Lecture of the Royal Society of Arts, London. This is the determination of X-ray exposure by the colour change occurring in the Sabouraud-Noire or Levy pastille under the action of the radiation, to which purpose the "Tintometer" (Lovibond) has been successfully applied by Dr. **DUDLEY CORBETT**. Several systems have been developed for the measurement of colours of low saturation ; such measurements are of importance in connexion with the manufacture of sugar, flour, cement, paper, and other "white" products, and also in laundry work.

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[1] *Journal of the Royal Society of Arts*, 1925, 73, No. 3766, 238-239.

Sir Francis Watts.

An Appreciation.

By Professor O. F. BOYD, B.A.[1]

The growth of scientific education and scientific methods of cultivation and manufacture of farm products has been very gradual throughout the West Indies. The necessity of a scientific and technical control over agricultural conditions and farming methods is realized universally to-day, although there are many who continue to adhere to the old traditions and methods

This realization of the value of science was not brought about, however, in any short length of time, nor by any particular event, but the process has been one of evolution and progress, and would cover a period of perhaps three-quarters of a century.

In looking back over this era of growth, one is confronted with the life histories of the pioneers of science who have devoted their lives to the cause, and carried on in the face of hardships and adverse conditions.

Foremost among these pioneer scientists stands SIR FRANCIS WATTS, K.C.M.G., D.Sc., who no doubt has done more toward bettering agricultural and farming conditions in the West Indies than any of his colleagues. He has devoted his entire life to the cause of science, and has been rewarded by seeing his numerous schemes and suggestions for improvements result in a practical and financial success. His contributions to the betterment of agricultural methods are numerous, and in almost every case have been successful and are a direct help to estate and factory owners throughout the world.

Dr. Watts's first appointment was the post of Government Chemist in Antigua, the capital of the Leeward Islands. In Antigua his work was mainly directed toward the study of various varieties of the canes, local soil conditions and the problems which these two fields of study presented as to fertilization and the selection of varieties best adapted to the local soil and climatic conditions. Sugar was manufactured during this period by the crudest methods and the final product was what is known as muscovado sugar, a very dirty molasses sugar. A large percentage of the sugar was lost in the bagasse and the extraction of juice was very low.

Dr. WATTS studied very closely the methods of manufacturing muscovado, and found them to be crude and wasteful, and came to the conclusion that it would be better for all parties concerned to organize and erect a central factory which would operate with modern methods and modern machinery. To this central factory the estate owners and cane growers would send their cane and an agreement or basis of payment could be arrived at. This proposal or suggestion was made to the estate owners in Antigua, but did not meet with approval. After several years had elapsed, however, the idea was again taken up by a group of English capitalists and a small central factory was erected at Gunthorpes in Antigua, to which the estate owners had agreed to send their canes. This was the first central factory to be established in the British West Indies. Its success was immediate and its establishment was followed by others throughout the West Indies. Dr. WATTS was largely responsible for the idea of the centralization, and it was through his efforts and literary contributions along the subject that the plan was eventually carried out.

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[1] In *Tropical Agriculture.* Vol. II, No. 1, pp 5-6.

In May, 1898, Dr. WATTS was selected for the post of Government Chemist in Jamaica. Although he remained there only a short time he contributed greatly to the needs of the planters, advising them as to soil and agricultural problems, and has visited the Island several times since and given advice when needed. It was upon his return from Jamaica that Dr. WATTS was appointed Superintendent of Agriculture for the Leeward Islands, in connexion with the newly established Imperial Department of Agriculture. The post of Government Chemist was also included in the appointment. It was during this period that he became interested in the re-establishment of Sea Island Cotton as a resource in the West Indies. His contributions to the literature and scientific journals concerning this product received widespread attention, and assisted largely in the re-establishment of the industry.

In January, 1909, Dr WATTS was appointed Imperial Commissioner of Agriculture for the West Indies with headquarters in Barbados, and the department was afterwards moved to Trinidad. He was knighted in 1917, as a recognition of his services to the Empire.

The establishment of the Imperial College of Tropical Agriculture was effected in 1921, and the post of Commissioner of Agriculture was combined with that of Principal of the College. SIR FRANCIS was largely instrumental in the establishment of the College, and made numerous appeals and proposals to the various Governments and Presidencies, pointing out the benefits which might be derived from an Agricultural College in the West Indies. The College is now located at St. Augustine, Trinidad, and is doing splendid work along agricultural lines. Students are enrolled from various islands throughout the West Indies, and several post-graduate students have come out from English Universities to study tropical agricultural conditions. The beneficial results of the College are obvious and it is a great aid to the agricultural world in contributing results of experiments and research work.

SIR FRANCIS has been more interested in the sugar industry than in any other branch of agriculture, and is the author of many valuable articles upon the subject. He has also written a book upon the manufacture of sugar which was published several years ago. Keenly interested in sugar he urged the establishment of a department of Sugar Technology in the College and this has been accomplished.

The department of Sugar Technology is peculiarly fortunate in having an experimental factory at its disposal for research and experimental work. This factory is largely the gift of British manufacturers of sugar machinery and SIR FRANCIS was directly responsible for its erection. The splendid opportunities for research and investigation in a department so well equipped are easily recognized, and the factory will be a lasting tribute to his efforts in the interest of education.

SIR FRANCIS retired from the active principalship of the College and as Imperial Commissioner of Agriculture on October 31st, 1924, and was succeeded by Dr. H. MARTIN LEAKE. He was made Principal Emeritus and continues to live in Trinidad. The importance and scope of his contributions to science and education cannot be over-estimated and will live for many years hence. One might safely say that the name of FRANCIS WATTS has been synonymous with progress and science, and his career in the West Indies has set a splendid example of diligence and steadfastness of purpose to guide other scientists who might follow him.

Note on Some Indian Canes.

By NOËL DEERR.

Whereas in most parts of the world drainage is considered of the first importance in sugar cane agriculture, in Northern India there are extensive areas where sugar cane is grown in low lying land which is submerged for a greater part of the year.

These varieties, of which several may be distinguished, seem on casual inspection to be somewhat remote from the noble canes, being slender, having swollen internodes, and in proportion to diameter having a thick outer rind. The fibre is high, running to about 16 per cent. On the other hand they often afford juice of high sugar content and purity, a sample of Hatthoni taken on October 17th, 1924, from cane planted in February, giving juice of 18·9 Brix, 15·9 Sugar, 86·5 Purity.

A photograph showing cane and rice culture combined with fishing in the same field is presented herewith. The exact locality is Rewa Ghat on the East Bank of the Barra Gandak, 25 miles west south west of Muzaffarpur. Rice is seen in the foreground, in the middle distance is Hatthoni cane, while in the far distance is also seen cane of a non-resistant type (on higher ground of course).

A number of varieties of these peculiar canes are grown in Behar, other varieties being Baruk, Nagori, Sewari, Kewali and Haruki.

According to the *Netherlands Indies Review* Java's exports of sugar to British India from January to the end of September, 1924, amounted to 317,000 tons, the total imports being 371,000 tons as compared with 363,000 tons during the same period of 1923 and 365,000 tons in 1922.

The British Consul at Tamsui reports that the second official forecast of the 1924-25 season's sugar production in Formosa is for 7,566,870 piculs of centrifugals and 243,063 piculs of brown sugar, or a total of 7,806,933 piculs, equivalent to 461,000 tons. These figures show an advance of 127,815 piculs as compared with the first forecast, and an increase of 271,286 piculs over the final figures for last season.

Data on Alcohol Motor Fuel in the Philippine Islands.[1]

By HERBERT WALKER.

During the past two years there has been developed in the United States a commercially practicable and economical method for producing absolute alcohol by continuous distillation without the employment of dehydrating agents. For use in internal combustion engines, it has heretofore been found necessary, to insure quick starting, to blend the alcohol with ether (as done locally) or with gasoline (as used in the so-called "National Fuel" of France, which consists of 70 parts alcohol to 30 parts gasoline). Both these formulae have their disadvantages. Ether is probably the most expensive factor in producing motor spirit in this country, while in the French formula an imperfect mixture results unless nearly absolute alcohol is used (the presence of 5 per cent. water being enough to cause a separation). But the dehydration of alcohol by continuous distillation has removed one serious defect in the production of this fuel and may be of considerable importance in determining the future price of gasoline in the Philippines.

Among new industrial uses, alcohol may be used for the production of: *Tetraethyl lead*, an "anti-knock" compound, which when added to gasoline in the proportion of about 1 to 1000 prevents detonation in engines having up to 155 lbs. per sq. in. compression. By increasing the compression made possible by such non-detonating fuel, it will be possible to build automobile engines to double the present mileage obtained per gallon. "Ethylized" gasoline is now sold by service stations at a price of 3 cents per gallon above the price of ordinary spirit. *Ethylene.*—This new anesthetic is reported to have some very decided advantages over ether and chloroform. *Artificial Silk.*—Over two million gallons of alcohol-ether mixture are used annually in dissolving collodion for this production. *Commercial Pectin.*—As a base for jellies this substance is increasing rapidly. A mixture of ethyl acetate and alcohol is employed as a precipitant in its manufacture.

Mr. A. O. BAIGRIE has submitted a report on the activities in Alcohol production on Negros, from which the following is extracted;—

It is estimated that next season the three plants in the P. I. require to distil 5 million gallons, the capacity of each distillery being increased very considerably. In the Talisay distillery a new French rectifying plant has been installed. It is a continuous process still of a capacity of 14,000 proof litres daily of high-grade alcohol which can be used for motor fuel without rectification. This will speed up the production of the Talisay distillery to a very great extent.

During the past season, which is the first that has seen the utilization of motor fuel on Negros, approximately 200,000 gallons was used locally in tractors and trucks while 50,000 gallons were shipped for use in the Manila district. Many of the existing tractors which, up to this season, were run on gasoline are being adjusted for alcohol fuel. The tendency of the more advanced of the *hacenderos* on Negros to use up-to-date methods in their cultivation has been responsible for the purchase of quite a large number of tractors to be run most of them on alcohol fuel.

There is a very much larger demand especially in China for rectified alcohol than for motor fuel and the fact that this market is able to absorb all the alcohol produced in the Philippines is one of the reasons that more has not been done to popularize the use of alcohol as motor fuel. Where this fuel was given a fair and intelligent test it proved to be just as efficient as gasoline, while the average of the tests showed a consumption of only 10 to 15 per cent. more. This of course is more than discounted by the lower cost per gallon, and to *hacenderos* who participate in the share of the production from their waste molasses the saving is very considerable.

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[1] Report (abridged) of the Committee on By-Products and Alcohol Fuel presented to the Second Annual Convention of the Philippine Sugar Association.

There is also an increasing field of usefulness for alcohol in the household as a fuel for cooking. Many of the stoves which heretofore used oil or gasoline have been found to operate just as successfully on alcohol, which has this advantage over gasoline that it requires no priming. There is also no danger of explosion with a consequent diminution of fire risk.

Within the last few months a strong demand has grown up for fusel oil (which is of course a by-product of the distillation of alcohol), for which a ready market is found in Japan. This is the more valuable in that it utilizes what was until recently a useless by-product.

The Mechanical Theory of Sugar Boiling and Curing.

By P H PARR.

(*Continued from page 41*)

The relations given in the first portion of this paper are sufficient for most purposes, but there are a few calculations which are often required, and which cannot be made directly without a slight further analysis: such as, for instance, the question of the concentration to which a massecuite must be boiled, in order to yield a sugar of given purity by straight curing, without washing. The solution of these problems is greatly facilitated by introducing the ratio :—

$$Q = \frac{W}{V}$$

from which it follows :—

$$K = \frac{Q}{N(1+Q)}$$

$$P_2 = \frac{1}{1+Q}$$

$$S_2 = \frac{V(1+Q)}{1+V(1+Q)}$$

and this leads to the important relation :—

$$P_3 V Q^2 - (N+V)(1-P_3) Q - N(1-P_3) = 0,$$

which is a simple quadratic equation in Q; so that the value of Q, and hence of all the other values necessary for a particular sugar purity P_3, can readily be calculated. It is also worth noting that the massecuite concentration is :—

$$S_1 = \frac{W}{1+W-P_1}$$

For instance, to find the concentration to which it is necessary to boil a massecuite of 0·75 purity in order to yield a sugar of 0·93 purity, when cured at 50°C., we have: $P_3 = 0{\cdot}93$, $V = 2{\cdot}52$, and $N = 15$ as here adopted; hence :—

$$0{\cdot}93 \times 2{\cdot}52\, Q^2 - (15 + 2{\cdot}52)(1 - 0{\cdot}93)\, Q - 15\,(1 - 0{\cdot}93) = 0,$$

or,

$$2{\cdot}3436\, Q^2 - 1{\cdot}2264\, Q - 1{\cdot}05 = 0,$$

and solving the quadratic in the usual manner :—

$$Q = \frac{1{\cdot}2264 + \sqrt{1{\cdot}2264^2 + 4 \times 2{\cdot}3436 \times 1{\cdot}05}}{2 \times 2{\cdot}3436}$$

$$= 0{\cdot}980,$$

whence $W = Q\,V = 0{\cdot}980 \times 2{\cdot}52 = 2{\cdot}47$; $S_1 = \frac{2{\cdot}47}{1 + 2{\cdot}47 - 0{\cdot}75} = 0{\cdot}901$, and all of the remaining estimations as to concentrations and purities can readily be made, as shown in the previous examples.

Tables of the various ratios have been carefully calculated, and have been used in deducing the values indicated in the boiling schemes given below, but it is not proposed to lengthen these articles unnecessarily by the introduction of several pages of figures. The general results of the calculations are indicated by Figs. 1 and 2, the first showing the molasses purities corresponding to various straight-cured sugar purities at temperatures of 50, 60, and 70°C.; and the second showing the massecuite solid content, and the recovery, for various sugar purities.

The foregoing analysis covers the greater part of the calculations required in connexion with the subject of these articles, and we may proceed to a consideration of the results when applied to various methods of boiling and curing. For this class of work, there is, however, one special calculation which has often to be made, and which it is well worth solving in general terms. This refers to the case where a massecuite of given purity is to be boiled so as to yield a sugar of a definite purity, whilst a portion of the massecuite is to be retained—in practice cut-over to another pan—so that, when mixed with the molasses resulting from the curing of the first fraction, the mixture will have a definite purity to form the second massecuite.

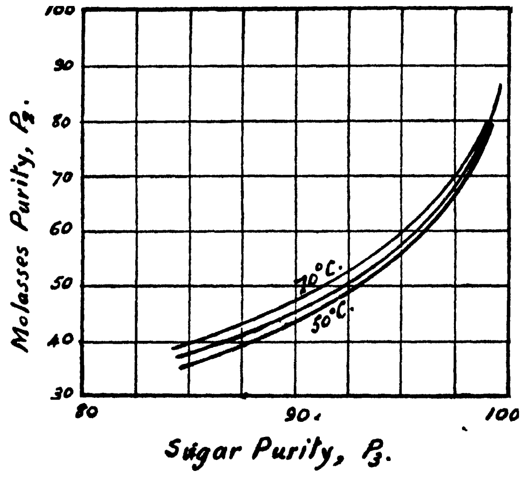
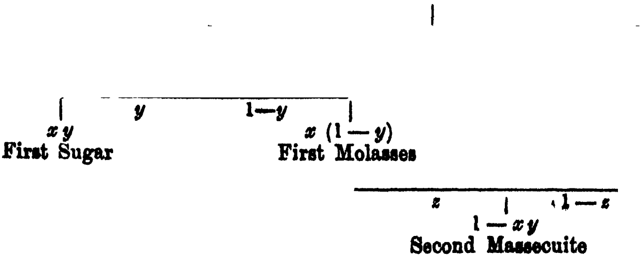


Fig. 1.

This scheme of boiling is in continual occurrence in practice, and is shown in the accompanying figure :—



one part by weight—solids only being considered—of first massecuite is divided into two portions x and $1 - x$, the first being cured in the centrifugals, and the second being cut-over. Of the massecuite sent to the centrifugals, the fraction y is separated as first sugar, and $1 - y$ is returned as first molasses. This molasses is then mixed with the first massecuite cut-over, in the ratio $z : 1 - z$, so as to give a second massecuite of a specified purity. The value of y is easily found according to the formulæ given previously, as is also the purity of the first molasses: the value of z is readily found from the purities of the first massecuite and molasses, and that required for the second massecuite; whence it follows at once that the fraction of the first massecuite to go to the centrifugals is:—

$$x = \frac{}{1 - y\,(1 - z)}$$

For instance, a first massecuite of 0·85 purity is to be boiled and cured to give a first sugar of 0·97 purity: a portion of this first massecuite is to be cut-over and mixed with the molasses resulting from the first curing, so as to give a second massecuite of 0·70 purity.

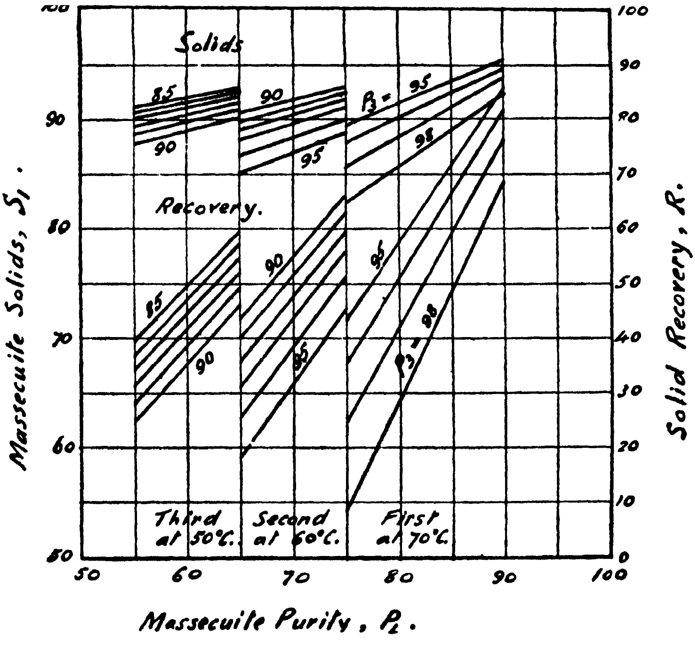


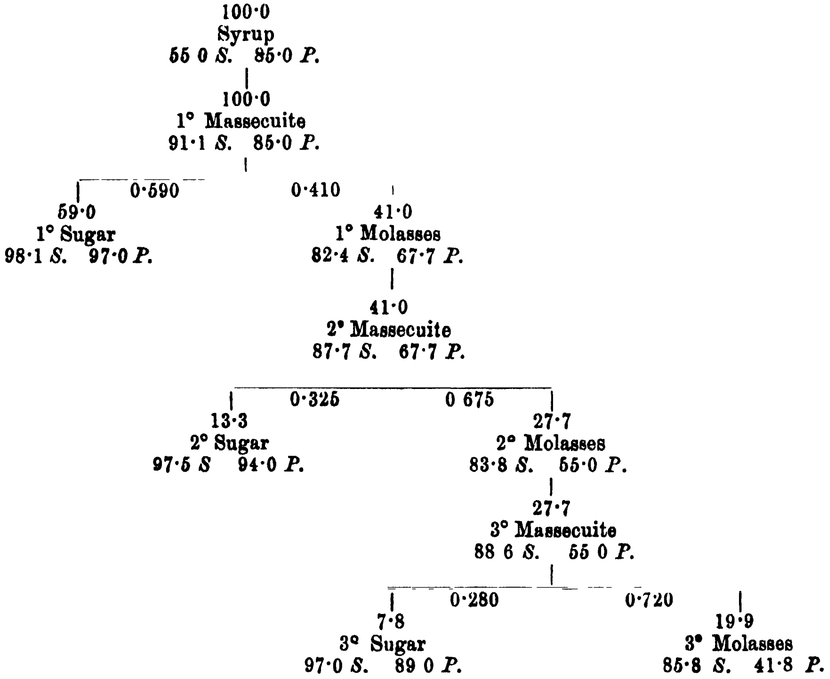
FIG. 2.

Making the calculations in the manner indicated previously, with a curing temperature of 70° C. for the first massecuite, it will be found that the first recovery, or y, is 0·590, and the purity of the first molasses is 0·677: therefore a second massecuite of 0·70 purity must be composed of $z = 0{\cdot}867$ parts (solids) of first molasses, and $1 - z = 0{\cdot}133$ parts of first massecuite: whence:—

$$x = \frac{0{\cdot}867}{1 - 0{\cdot}590\,(1 - 0{\cdot}867)} = 0{\cdot}941$$

parts of the first massecuite must be sent direct to the centrifugals, and 0·059, or say, 6 per cent., must be cut-over to the second massecuite.

The following diagrams show the results of calculations made on the lines indicated above, for three of the simpler boiling and curing schemes, for a syrup of 0·85 purity and 0·55 solids (say 82 per cent. apparent purity and 58° Brix), with sugars cured at 70, 60, and 50° C. respectively to purities of 0·97, 0·93, and 0·89. It will be noted that the values thus estimated are in reasonable accordance with actual factory returns, and they are much closer than those found by any other method which the writer has so far seen published; in fact, most of the older written matter merely states that from a given massecuite we may expect to obtain a molasses of about twenty points lower purity; or else simply gives the formula for the sugar recovery for stated purities of massecuite, molasses, and sugar, ignoring altogether the vital question as to whether or no such massecuite can be separated in the centrifugals into such sugar and molasses. In the diagrams, the quantities of course refer to the solid content only, and the total weights are to be obtained by dividing by the corresponding values for *S*.[1] *S* and *P* are given in the diagrams as percentages instead of as decimals.



Solid recovery	80·1 per cent.
Sucrose recovery	90·2 ,,
Mean Sugar purity	95·7 ,,
First Sugar..	73·7 per cent. of total.

The more elaborate boiling and curing schemes can be worked out on the lines indicated above, although usually the process has to be worked through several times until a balance is obtained. The theory of washing and double curing with affining syrup, white molasses, or clairce, as it is variously termed, has also been worked out approximately, but this problem will not here be considered.

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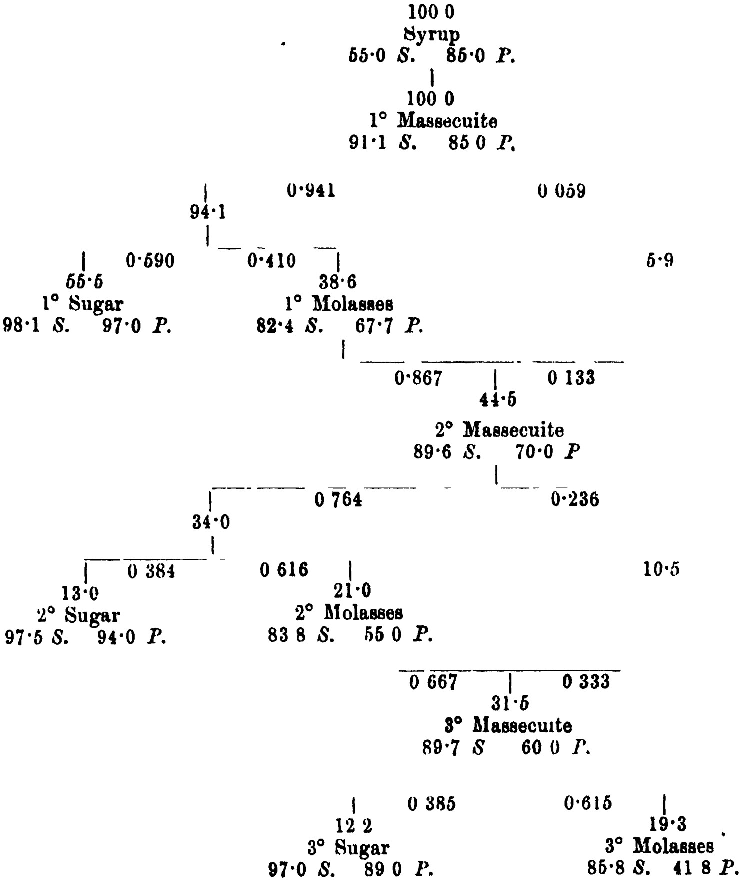
[1] For the three schemes shown, it will be noticed that there are but little differences between the total recoveries, but that there are very important differences between the amounts recovered as first sugar, and hence in the total market value of the sugars.

When making boiling and curing estimations on the lines indicated in these articles, where absolute values only may be used for the calculations, it may be well to give a warning that the purity of the exhausted molasses should never be taken as lower than 41-42 per cent. An exhausted molasses of 30 apparent purity is often quoted as typical, but actually such a molasses is abnormal. The mean apparent purity of exhausted molasses, from twenty Cuban Centrals, ten Philippine Centrals, ten years' averages for Java and Hawaii, and various factories in the Argentine, Peru, etc., is 33·5, corresponding approximately, according to the table by the writer,[4] to a gravity purity of 39·0 and to an absolute purity of 41·7.



Solid recovery	80·7 per cent.
Sucrose recovery	90·5 ,,
Mean Sugar purity	95·3 ,,
First Sugar..	68·8 per cent of total.

From the boiling schemes, it is easy to calculate the quantities of the various grades of massecuite and molasses to be dealt with, and hence the machinery capacities required. For the vacuum pans, it is to be noted that the evaporation is usually a secondary consideration, and it is the strike capacity that forms the basis of design. In many cases, a normal pan strike capacity (say to one foot below the top of the belt) of about twelve hours on first massecuite, will be a suitable allowance, but the boiling scheme and other circumstances may modify this considerably. If "slow-boiling" is adopted, 50 or even 100 per cent. more pan capacity may be employed: a strike grained low-down, for large crystals, takes much more time than a strike grained high-up for small crystals; and so on.

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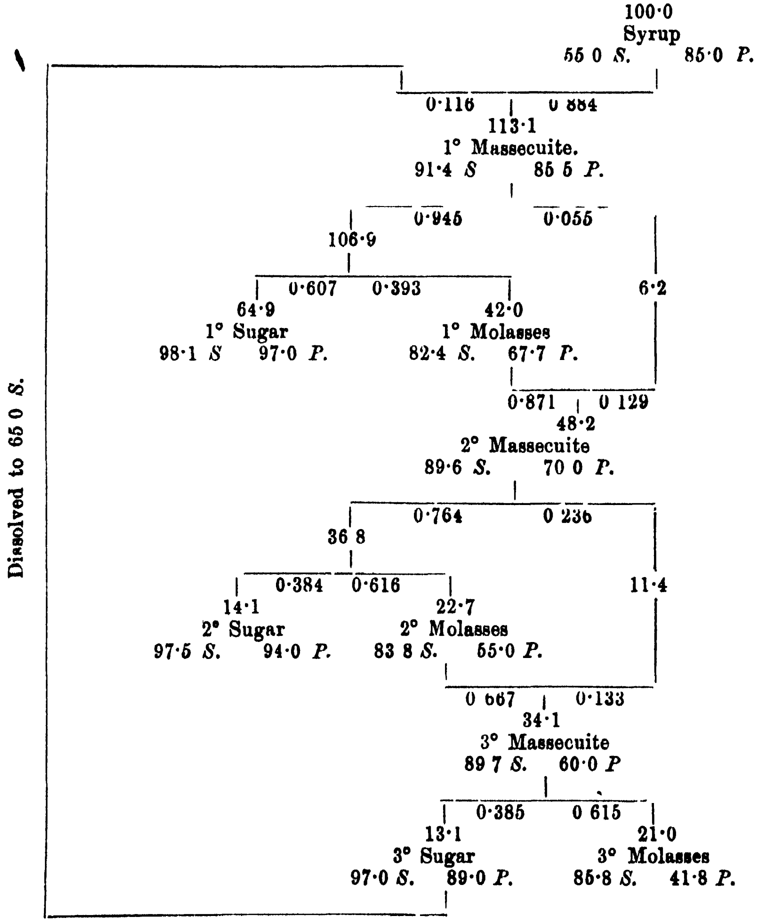
[4] *I.S.J.*, 1924, p. 311.



Solid recovery	79·0 per cent.
Sucrose recovery	89·6 ,,
Mean Sugar purity	96·4 ,,
First Sugar	82·1 per cent. of total.

This subject is of great importance to the designing engineer, and estimations made on the lines indicated above will usually provide a very fair basis for machinery design. The theory involved is quite simple, although the exposition is somewhat long, and the calculations themselves, if tedious, are quite easily made.

Determination of the Hydrogen-ion Concentration of Cane Juices in Natal and Mauritius.[1]

By R. G. W. FARNELL,
Chemist, British Empire Sugar Research Association.

Hitherto we have chiefly concerned ouselves with measuring the total acidity or alkalinity of a solution by titration, generally using phenolphthalein as indicator. Normal solutions of sulphuric and of phosphoric acids both require the same amount of alkali for neutralization, and thus the total (potential) acidity of each is identical. Yet their effect on the inversion of sucrose is widely different. For the same conditions of time and temperature, the sulphuric acid will invert about ten times as much sucrose as the phosphoric acid. The sulphuric acid is more dissociated into hydrogen-ions than is the phosphoric acid, and its "hydrogen-ion concentration" is higher. Different acids in solution split up into ions to a very different extent. Hydrogen-ion concentration is a measure of the "effective acidity." A very convenient method of expressing the hydrogen-ion concentration of a solution is by means of the symbol "*pH.*" A *pH* of 1·0 means 1/10 grm. of hydrogen-ion per litre; a *pH* of two (*pH* 2) means 1 × 10 × 10 ($1/10^2$) grms. per litre, etc. Thus *pH* 1 expresses a higher concentration of hydrogen-ions than *pH* 2. At *pH* 7 ($1/10^7$) there are as many hydrogen as hydroxyl-ions in solution, and we have absolute neutrality. At any *pH* numerically greater than 7 the solution is alkaline. The greater the figure, the greater the effective alkalinity, and maximum alkalinity is reached at *pH* 14, a figure only given by caustic alkali. Thus we have strong mineral acids as hydrochloric and sulphuric acids giving a *pH* of 1-2 in aqueous solution, and weaker acids such as sulphurous and acetic a *pH* of 2-4; cane juice gives a *pH* of 5-6 (roughly).

The measurement of *pH* can be carried out by two methods: (1) Electrometric; (2) colorimetric. The first gives more exact results than the second, but is much more difficult, whereas the colorimetric method is very simple and is finding application in the sugar industry. There are seven indicators (usually referred to as Clark and Lubs' indicators) which have a definite colour at a definite *pH*. The list given below shows these indicators, their proper concentration, colour change, and range of *pH*. I have found the Clark and Lubs indicators marked (*) especially useful in sugar factories. Approximately half a c.c. of indicator solution is added to approximately 10 c.c. of the solution to be examined. For coloured products such as are always found in practice it is

Indicator.	Concentration Per cent.	Colour change.	*pH* range.	Application
Thymol blue	0 04 ..	Red-yellow ..	1 2–2 8 ..	—
*Brom phenol blue ..	0·04 ..	Yellow-blue ..	3 0–4·6 ..	Sulphured juice
*Methyl red	0·02 ..	Red-yellow ..	4 4–6·0 ..	Raw juice, "clairce," etc.
Brom cresol purple	0·04 ..	Yellow-purple ..	5·2–6·8 ..	Clarified juice.
*Brom thymol blue	0·04 ..	Yellow-blue ..	6·0–7·6 ..	Limed juice, clarified juice, "clairce," raw juice.
Phenol red	0·02 ..	Yellow-red ..	6·8–8·4 ..	Limed juice, alkaline juice from filter-press.
*Cresol red........	0 02 ..	Yellow-red ..	7·2–8·8 ..	Alkaline juice from filter-press.
Thymol blue	0 04 ..	Yellow-blue ..	8·0–9·6 ..	Alkaline juice from filter-press.
Litmus	— ..	Red-blue ..	5·0–8 0 ..	—
Phenolphthalein ..	— ..	Colourless red ..	8 3–10 0 ..	—

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[1] Summary of a Lecture delivered before the Société des Chimistes, Mauritius, in October, 1924. A fuller account of the *pH* of various juices, the result of later work by Mr. FARNELL, will be published shortly.

permissible to dilute considerably; for instance, 2 c.c. of juice are diluted to 10 c.c. using water of *pH* 7. "Colour Charts" of indicators which show the colour of any indicator at any *pH* within its range are readily obtainable. Full details will be found in the standard book on this subject, "The Determination of Hydrogen-Ions," by W. M. CLARK.

As far as I am aware, the first chemists to introduce *pH* into the cane sugar industry were BREWSTER and RAINES.[1] It will be seen from the above table that litmus covers true neutrality *pH* 7, but that its range is greater than the Clark indicators while it loses in accuracy. With phenolphthalein on the other hand, the *pH* range is less than litmus, but unfortunately it does not cover neutrality, since it does not start turning perceptibly pink until *pH* 8·4–8·5. For sugar factory work, the indicator brom thymol blue is extremely useful. It has a range from slightly acid (*pH* 6) to slightly alkaline (*pH* 7·6).

With the aid of these indicators, I have determined the *pH* of the different products in many factories of Natal and of Mauritius. The following table gives average figures:—

pH.	Raw Juice	Sulphured.	Limed.	Clarified.	Clairce or Syrup	Filter-press Juice.
Natal......	5·4	3 6	6·9	6·4	6·2 (no P_2O_5)	7·6
Mauritius..	5·8	3 8	7·0	6·7	6·5 (no P_2O_5)	7·9

On the whole the juices carried are more acid in Natal than in Mauritius. The volume and rate of settling of the "muds" depend on the *pH*. If in Natal the juice after sulphuring were limed back any further than *pH* 7, the muds would take very much longer to settle. Yet in Mauritius I have seen factories liming back to *pH* 7·4. It is impossible to state definitely once and for all the best *pH* to work the juices, since the nature of the impurities in the juice varies much in different countries.[2] However, a good operator at the liming tanks can keep the *pH* of the juice within narrow limits by noting the separation of the precipitate when the juice is poured into a small bottle. This is the method universally employed in Mauritius, and I have found a remarkable constancy in the *pH* of the juices of those factories which I have visited more than once.

There are present in cane juice certain substances such as proteins, amino-acids and amides, phosphates, and organic acid salts which are termed "buffers." These substances tend to oppose stronger acids and prevent them from dissociating, and thus the hydrogen-ion concentration in the presence of buffers is lower than in their absence. The buffer action of juices varies considerably and is much greater with raw than with clarified juices. On heating the limed juice albumin is coagulated and the juice becomes less buffered; consequently the acid in the juice dissociates more easily and the hydrogen-ion concentration rises, which means a lowered *pH*. The *pH* of the clarified juice is nearly always lower than the limed juice.

One can get some idea of the different buffer contents of cane juices, etc., by comparing the *pH* and the total acidity as determined by titration with caustic alkali using phenolphthalein as indicator. The following figures were obtained in Natal:—

JUICE.	*pH.*	Acidity in c.c s of N/10 NaOH, neutralized by 10 c c. of juice, etc.
Sulphitation A, clarified . ..	6·3	1·50
Sulphitation B, clarified..	6·3	1 10
Carbonatation, clarified	6·3	0·60
Refinery char-filtered, water-white liquor	6·3	0·07

The most "buffered" juice is that of sulphitation A, while the water-white char-filtered liquor is scarcely "buffered" at all.

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[1] *I.S.J.*, 1923, 88.

[2] BREWSTER and RAINES (*loc cit*) recommend for Louisiana juices to sulphur and lime back to pH 7·0. Under these conditions WALTON (*I.S.J.*, 1924, 312) finds little, if any, inversion.

Mauritian Pen Manure.[1]

By Professor F HARDY, M.A.

There is no need to extol the many virtues of pen manure, or to reiterate the need of its greater employment in tropical agricultural practice. The main problem that confronts the planter in these days of mechanical tillage is how to manufacture larger quantities of pen manure with diminishing numbers of farm animals.

Bacterial transformations in the making of pen manure.—It is well known that pen manure consists of two main components, animal excretions and litter. Of the former, urine is by far the more important. It not only contains compounds of immediate fertilizing value, but also furnishes nitrogen to the organisms that bring about the decomposition of the cellulose of the litter into brown humus-like substances. Much of our knowledge of the cellulose-decomposing organisms is due to the researches of Dr. HUTCHINSON and his co-workers at Rothamsted. These investigators have demonstrated that four main factors control the rapid multiplication of the more effective bacteria capable of decomposing cellulose. These factors are: (1) An adequate supply of air; (2) an adequate supply of moisture; (3) a sufficiency of inorganic, or simple organic, nitrogen compounds; and (4) the absence of certain specific toxins, such as reducing sugars and *higher* organic nitrogen compounds. In the absence of an adequate nitrogen supply, however, it is interesting to note that deficiencies may be made up by the activity of certain nitrogen-fixing bacteria which can thrive on the first-formed decomposition products of cellulose, provided these products include readily oxidizable substances. Thus the nitrogen-fixing bacteria may work in conjunction with the cellulose-decomposing organisms, and thereby augment the initial supply of suitable nitrogenous material in the medium.

Artificial and Mauritian pen manure.—A natural outcome of the investigations of the Rothamsted workers was the formulation of a method for making artificial farmyard manure by treating straw with water, ammonium sulphate and finely ground limestone. This process has recently been patented, and its application will probably greatly aid in solving the problem of maintaining the humus supply of cultivated soils. In quite another connexion, yet closely related to this subject, the Rothamsted researches have fully confirmed the soundness of a practice advocated many years ago by certain planters in Mauritius, whereby the output of pen manure on sugar cane estates may largely be increased. Briefly, the practice consists in spreading machine-cut cane trash, herbage, or bush to a depth of 2 ft. on the floor of a covered pen. Cattle are turned into the pen daily for a fortnight. At the end of this period, the urine-soaked litter is transferred to a pit whose floor and sides are composed of concrete or stone. In the pit, the moist material must not be stacked too loosely, else excessive decomposition, leading to "fire fang," may occur. Nor must it be packed too tightly, for exclusion of air may result in the formation of a sort of silage, owing to the development of an undesirable type of bacterial activity. The pen is afterwards again spread with cut litter, and the cycle repeated. When the contents of the pit have broken down properly, the manure is carted to the fields for spreading, or suitably stored until needed. The changes that go on in pen and pit are probably somewhat as follows. The simpler nitrogenous compounds present in urine, chiefly urea, are either immediately utilized by cellulose-decomposing organisms naturally present in small numbers on the litter, or are quickly rendered available by conversion into ammonium compounds by fermentation. The organisms break down some of the cellulose of the litter, and thereby produce a suitable medium for the growth of nitrogen-fixing bacteria. These furnish simple nitrogenous compounds which quickly augment the nitrogen supply of the original medium, and allow of the further multiplication of the cellulose-destroying organisms. The process is therefore cumulative, and eventually the greater part of the litter is changed into humus. The end product is not only in a very suitable form for application to the land, but it also contains much greater amounts of nitrogen than can be accounted for by the relatively small quantity of urine originally present in it, because the nitrogen-fixing bacteria have also added their share of acquired nitrogen to it.

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[1] Reproduced from *Tropical Agriculture*, Vol. 1, No. 8, 116-118.

Advantages and disadvantages of the Mauritius method.—The chief obvious advantage of the Mauritius method for making pen manure is that much larger quantities of cellulosic material can be converted into manure by the penning of a limited number of animals, than is possible when the customary process of preparing pen manure is practised. Moreover, the Mauritius method may be adapted to the conversion into manure of widely diverse kinds of cellulosic material, such as straw, trash, grass, roughage, bush, and possibly even bagasse. Strictly ærobic and properly moist conditions must be maintained, however, for the method to prove successful. Its most serious disadvantages are the high initial cost of the trash cutter, pen and pit, and the expense of handling the manure during its preparation. On small estates, or under systems of very intensive cultivation, the Mauritius method may not, of course, be practicable, because it may not be worth while to use valuable land for producing the requisite material for litter.

A Mauritius pen in Trinidad.—Through the courtesy of the Manager of the Ste. Madeleine Sugar Company, the writer is able to present the following data relating to a large-scale experiment carried out at Cedar Hill Estate, Trinidad. The plan of adopting the Mauritius system for increasing the supply of pen manure to the sugar cane lands of the Company was suggested in 1923 by Mr. G. A. Jones, Agronomist in charge of Field Experiments. The pen is 100 ft. long by 30 ft. wide. It is divided into two equal compartments. Alongside the pen, and running its whole length, is a pit, 20 ft. wide and 6 ft. deep. A low wall surrounds both pen and pit. The floor and wall are made of concrete, and the whole is sheltered by a galvanized iron roof. A trash cutter and blower-elevator, driven by an oil engine, are suitably housed in a small shed adjacent to the pit. In operation, one of the compartments of the pen is initially filled to a depth of 3 ft. with finely chopped litter. It is generally not necessary to add water to the litter, but provision is made for a water supply to be used when bagasse is mixed with the litter, and during dry months when vegetation is parched. Cattle (20 head) are turned into this compartment daily for 14 days, litter being added each day. The second compartment of the pen is then put into commission, and the stock turned into it, whilst the contents of the first are transferred to the pit. By this plan, 2000 tons of manure can be made per annum by 20 head of stock, or 100 tons per annum per head. By the ordinary method of preparing pen manure, only 20 tons can be made per annum per head, so that the Mauritius method is five times the more productive, under the conditions of this particular experiment. It is not necessary here to record the cost of cutting and carting trash and grass for litter, and of emptying the pen. The Manager of Cedar Hill Estate, Mr. E. E. Fabien, is convinced that, if a sufficient quantity of grass or other vegetation suitable for conversion into manure, can be grown on waste lands bordering railway lines, the Mauritius system will provide him with enough pen manure to apply to ratoons, as well as to plant canes. Formerly it was difficult to get sufficient material even for manuring plant canes alone. Furthermore, the new method will permit substantial reductions in the necessary quantity of stock, and it is expected that it will largely reduce the cost per ton of sugar cane produced.

As regards the comparative fertilizer value of pen manure made by the Mauritius method, the results of analyses performed by the writer and recorded in the accompanying table, furnish sufficient evidence to prove that it may differ but little from, and may be even superior to, pen manure prepared in the usual manner. The material analysed was obtained by the method of sub-sampling from three 60-lb. samples of manure obtained from (A) an ordinary covered pen, in which fodder and bedding had been trampled by stock for three months, (B) one of the compartments of the Mauritius pen after three weeks trampling, and (C) the pit, where manure similar to (B) had been allowed to decompose for an additional ten days.

Sample.	Moisture. Per cent.	Ash Per cent	Organic matter. Per cent.	Soluble humus † Per cent.	Total Nitrogen. Per cent.	Nitrogen as Ammonia. Per cent.
A	74·2	7·9*	17·9	12·0	0·184	0·005
B	78·0	3·8	18·2	12·3	0·216	0·002
C	77·0	4·3	18·7	14·0	0·220	0·0025
Average English farmyard manure	76·0	6·0	18·0	—	0·620	0·020

It should be noted that sample A differed from the others in being coarse and long in texture. One of the main factors for success in the Mauritius method is a comparatively fine texture in the pen litter. This enables it to take up and to distribute the urine of the animals that trample it, and thus to induce uniform decomposition throughout the mass. In conclusion it may be stated that one week's storing in the pit usually suffices for the production of a satisfactory manure. The material should then be spread at once, or piled in heaps until needed. To prevent "fire fang," and to minimize wasteful decomposition, the manure store-heap should be compacted during its formation by passing the carts across it. The heap may further be protected by covering it with a layer of soil, and by erecting over it a rough shed to shelter it from rain.

An extension of the railway in Zululand, in a new district known as the Hluhluwe River area, is expected to produce an addition to the sugar cane areas of at least 10,000 acres.

The American sugar beet crop for 1924-25 is expected to be the largest on record. Final figures are not yet available but estimates early in January put it at some 982,200 long tons, the previous highest total was that of 1920-21 when 972,340 tons of sugar was obtained. The million long ton mark is thus almost within reach.

R. S. CARPENTER, Manager of the Caribbean Sugar Co., Manopla, Cuba, has ordered a machine for fighting cane fires in the shape of an auto-truck provided with a 1200 gall. tank and a pump capable of delivery of a stream of water at a pressure of 600 lbs. at the nozzle, this being operated directly from the shaft of the truck engine.[1] A hose, 100 ft. long, and a specially designed nozzle, 6 ft. long, complete (in the main) the equipment, the theory of which is that a small amount of water delivered under high pressure will execute the same work in putting out a fire as a heavy solid stream under lower pressure. The pumping apparatus consumes 10 gall. of water per min. and throws it 150 ft., and trials are stated to have proved the machine to be eminently successful.

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* Containing extraneous clay, 2·7 per cent.

† Determined by Piettre's method of extracting humus with boiling pyridine

[1] *La. Planter*, 1924, 73, No. 20, 392.

The Rôle of Colloids in Cane Sugar Manufacture.[1]

By R. G. W. FARNELL,
Chemist, British Empire Sugar Research Association.

The separation of the colloids in cane juices and molasses can readily be effected by diffusion (dialysis) through a membrane of collodion. In this way we can isolate the following colloidal constituents[2]:—(*a*) Protein (chiefly albumin); (*b*) pentosan (one of the cane gums); (*c*) pectin; (*d*) wax; (*e*) tannin; (*f*) mineral matter (chiefly silica, also small quantities of lime, iron and alumina oxides).

There is much to be learned concerning the behaviour of these colloids in the different methods of clarification.

Albumin is partly coagulated on heating to 80-90°C., and more completely by heating at *pH* 5 than at *pH* 7.[3] The same applies to the colloidal silica which MULLER[4] has shown is not precipitated by liming the juice cold and afterwards boiling. Only by first heating the raw juice above 100°C., and then liming, is this colloidal organic compound of silica precipitated, a juice of great limpidity resulting. BIRD[5] has recently put Muller's claims to practice in Demerara where raw sugar is exclusively made and very successful results have been obtained. Certainly hot lime defecation would seem superior to the usual system both from the point of view of silica and albumin However, it seems difficult to combine hot defecation with sulphitation.

The pectin in the juice is precipitated in the form of calcium pectate if lime be added to the juice up to about *pH* 8.[6] However, in many cases this is not possible.

The pentosan does not seem to be removed by lime alone, but in both sulphitation and carbonatation it is partially removed by adsorption on the granular precipitates of calcium sulphite and carbonate. The same applies to the tannin, the ferric salt of which, according to ZERBAN,[7] principally accounts for the colour of cane juices.

The question of wax has recently received much attention in Hawaii by SMITH.[8] He has shown that the wax is the cause of the poor filtrability of Hawaiian raw sugars, and that if there is not sufficient phosphoric acid in the juice, clarification by lime is impossible. WALKER states that a crusher juice containing less than 0·03 per cent. of P_2O_5 usually will not clarify properly, and the remedy lies in adding phosphoric acid. It seems as if the wax is adsorbed by the calcium phosphate, together with many other colloids.

In general, sulphitation seems to remove more colloids than ordinary lime defecation, while carbonatation removes a still greater quantity.

I have determined the amount of colloids in different molasses, both in Trinidad and Natal as well as Mauritius. The following table shows some figures which can be regarded as average:—

NATURE OF MOLASSES.	Colloids per cent. Molasses.
Trinidad defecation..	1·5
Natal sulpho-defecation	1·0
Natal carbonatation..	0·3
Mauritius sulpho-defecation	0·5

There is much less colloidal matter in the juices of Mauritius than in those of Natal, especially in regard to wax, albumin and silica. From a few analyses I have made here (Mauritius) I find that over 80 per cent. of the colloids are removed during clarification.

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[1] Summary of a lecture delivered before the Société des Chimistes, Mauritius, in October, 1924.

[2] *I.S.J.*, 1924, 420. [3] *I.S.J.*, 1924, 359. [4] *I.S.J.*, 1921, 579.

[5] *I.S.J.*, 1923, 358, and *Louisiana Planter*, vol. 69, p. 61.

[6] *I.S.J.*, 1924, 480. [7] *Louisiana Bulletin*, No. 165, 1919. [8] *I S.J.*, 1924, 266.

When one remembers that clarification, viscosity and colour of sugar products are intimately connected with the colloids of the juice, and that these colloids again have properties which are changed at different concentrations of hydrogen-ion, the Sugar Research Association needs no excuse for devoting much time to studying the cane colloids in order to attain a fuller knowledge of these substances and their rôle in the process of manufacture.

Philippine Centrals: Annual Synopsis of Mill Data for 1923-24.[1]

By E. T WESTLEY

GENERAL REMARKS.

Data from 16 factories have been available, the production of which represents about 90 per cent. of the total Philippine centrifugal sugar production.

All factory results in this report are based on gross cane, and as the methods used in determining the per cent. sucrose in the different factories vary considerably, per cent. polarization in cane is used in most calculations.

Necessity of uniformity.—In examining the returns received from the different factories the writer has come to the conclusion that this synopsis cannot be used for a strict comparison of the results obtained in all these mills. The methods used in arriving at, and reporting, the different figures vary too much. Without going into detail a few points may be brought out. Fibre per cent. cane is reported in very different ways and is in most cases far from fibre per cent. gross cane. In the writer's opinion fibre per cent. gross cane should be reported as "Fibre in Clean Cane, and Fibre in Trash per cent. on Gross Cane." The method used in determining per cent. sucrose in the various products varies considerably and so do the results obtained[2]; some use the H.C.A. method; one Steuerwald's; others Walker's simplified inversion method, etc. Some factories have also corrected the weight of mixed juice by deducting weight of suspended solids.

Petree-Dorr process.—The two factories operating under the Petree-Dorr process during the last season represent about 14 per cent. of the total production covered in this report. This makes comparison with former years difficult, and also makes it difficult to compare these factories this year with other factories, since all undetermined losses up to the point of weighing the clarified juice are not taken into consideration. That there are liable to be considerable losses due to inversion in the Petree-Dorr process of clarification is very likely, as the writer understands the juice remains for four hours or more in the Dorr clarifier. There are also bound to be inversion losses due to the returning of the mud juice to the mill, as some of this juice no doubt keeps on circulating for a considerable time. For the reasons just mentioned the writer feels safe in stating that the factories operating the Petree-Dorr process report a lower loss and better recovery than they actually had, due to the method of chemical control.

Loss in shipping.—In the writer's opinion it is of just as great importance to make a good keeping grade of sugar, and to weigh and pack it correctly, as it is to get a high extraction at the mill and a low waste molasses, perhaps more so. Because if the actual weight of the sugar is less than the recorded weight one pays more for bags, freight and shipping charges than is necessary. There is bound to be a loss in weight due to leakage and drying out of the sugar *en route* under the present method of shipping sugar. But the increase in polarization between the P.I. and the U.S.A. should almost offset this, so that the amount of polarization shipped and sold should agree fairly closely in the case of a properly made sugar. A factory showing a high recovery in this synopsis, but with big losses between factory and refinery, may not have as high a recovery of sugar paid for as a factory with a lower factory recovery but with very small, if any, loss *en route*. After all it is the recovery paid for that counts, not the recovery reported at the factory. The writer would recommend that for a final comparison of the different factories the tons polarization paid for be used instead of the tons polarization reported bagged. The standing of the different factories would then be very different from the standing according to this synopsis.

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[1] Report of the Committee on Annual Synopsis of Mill Data, presented to the Second Annual Convention of the Philippine Sugar Association.

[2] *I.S J*, 1924, 613.

Quality of cane.—The quality of the cane for 1923-24 was not as good as in 1922-23, but better than in the 1921-22 season. Negros as in former years has by far the better cane. For 1923-24 on Negros the average from one ton of cane is 128 kilos sugar; on Luzon 107 kilos; and on Mindoro 105 kilos. Mindoro has the highest per cent. fibre.

MILLING.

For the 1923-24 season 94·04 is the average extraction. This is not as good as in 1922-23, when it was 94·51, but better than the 93·39 in 1921-22. Only one factory reports over 96 extraction this last season against three during the 1922-23 season. The average per cent. polarization in bagasse was 3·39 or 0·08 higher this season than in 1922-23. There was also 0 07 increase in moisture in 1923-24 over 1922-23. From these figures one would reason that the mill work was not as good in 1923-24 as during 1922-23, but when we take into consideration that the tonnage fibre ratio was 2·26 higher, and the per cent. dilution was 6·18 less in 1923-24 than in 1922-23, it will be seen that the mills on an average did better work in 1923-24 than in 1922-23. That this year's figures include two factories using the Petree-Dorr process, and that also this year the extraction is figured on per cent. polarization in gross cane against former years' mixture of polarization, sucrose, gross and net cane, should also be remembered, these factors making the figures not strictly comparable. But it is safe to say, taking everything into consideration, that this year's milling work was better than any previous year.

BOILING-HOUSE WORK.

Clarification.—The average clarification was better last season than during the two previous years, judging by the increase in purity from mixed juice to syrup. Excluding the two Petree-Dorr factories, the average increase was 1·57 against 1·13 in 1922-23, and 1·38 in 1921-22. No factories reported decreases in purity from mixed juice to syrup during the 1923-24 season. In 1922-23 one factory and in 1921-22 three factories reported decreases.

Although the clarification was better last season than in former years, there is room for improvement in most factories. Good clarification will give easier worked low grades, higher recoveries, better keeping, and refining sugars. Some factories no doubt were forced to underlime due to limited settling and press capacity. But the proper amount of lime to use under Philippine conditions seems to be a point yet to be settled.

Filtration.—The average polarization per cent. press-cake was 3·71 and the moisture was 65·69 in 1923–24. This again is better than in any previous year. Taking into consideration that most of the factories were running over capacity, the mud-press work must be considered a great improvement over that of former years.

Evaporation.—The syrup Brix averaged 63·29 during 1923-24, the highest average yet reported. The rate of evaporation remained about the same, however, due to a higher mixed juice Brix in 1923–24 than formerly.

The writer feels sure that most factories have actually more entrainment than they think they have. His findings are that the rate of entrainment varies greatly, at times very small, and then all of a sudden high for a short period. Either a sudden variation of vacuum in the last cell had taken place or the difference between the vacuum of the last cell and the preceding cell was too great. Another cause was that when the flow of the juice through the evaporator was not even, the last cell had been given a big shot of fairly light juice. Great care must be used when starting up the evaporator, or heavy entrainment losses may result. Pans too are liable to entrain heavily at times, especially if water is taken in when the pan is pretty full. The writer would recommend that samples be taken regularly from all water legs, analysed, and reported just like any other material in the factory. Entrainment should have a place on all reports just like mixed juice. Occasional samples at irregular periods are liable to give misleading information.

Commercial sugar.—The average polarization is about the same this year as last, being 96·39 against 96·4 during the 1922-23 season. The moisture has dropped from 1·01 per cent. in 1922–23 to 0·93 per cent. in 1923-24. This is a marked improvement but further lowering of the moisture content is desirable.

Low grade work.—38·44 is the average gravity purity of waste molasses for 1923-24. This is the lowest average yet on record. But there is still room for great improvement, and the writer expects to see the average gravity purity of waste molasses down to 36·00 before very long.

Recovery.—Mr. H. J. CARSTEN has compiled a table showing the standing of factories according to the over-all recovery. He uses these figures :—

First Expressed Juice Analysis and an Assumed Molasses Factor :

$$\frac{\text{Gravity Purity of Molasses}}{\text{100—Gravity Purity of Molasses.}}$$

In his table a gravity purity of 36 has been used in all cases giving a molasses factor of 0·5625. From these he figures the theoretical piculs of sugar per ton of cane, eliminating all losses except those resulting from a waste molasses 36° gravity purity in the following way :—

Non-sugar in first expressed juice times molasses factor equals per cent. polarization lost crusher juice. Per cent. polarization lost crusher juice subtracted from polarization crusher juice equals available per cent. polarization crusher juice. Available per cent. polarization crusher juice times 10 divided by 63·25 kilos (one picul) gives the assumed theoretical piculs polarization per ton cane.

$$\frac{\text{Actual}}{\text{Theoretical}} = \text{per cent. recovery on theoretical.}$$

The writer realizes fully that the methods used in compiling such data for comparing factory results are not beyond criticism. Factories have different kinds of crushers, also different settings and loads on same. Per cent. fibre in cane varies also, so the first expressed juice extraction will differ. On the other hand, this table will eliminate any error in determining extraction, weight and analysis of mixed juice, weights and analysis of mud and waste molasses, etc. When everything is considered, it is as fair as any other method that could be devised.

Then taking the average over all recovery for all the factories, we find this to be slightly better in 1923-24 than in 1922-23. Average polarization in sugar per 100 polarization in cane is 85·67 in 1923-24 and 85·54 in 1922-23.

General Comments.

Seven factories report a total stoppage of less than 100 hours. By dividing the total sugar produced by the total grinding hours of all the factories we find an average of 6·48 tons sugar per hour for 1923-24. Treating the figures for 1922-23 in the same way we find the average for that year to be 6·19, while figures for 1921-22 show an average of 5·65 tons sugar per grinding hour. If we use the total operating time, that is, add the time stopped due to there being no cane and stoppages due to repairs, etc., in the factory to the total grinding time, we find an average of 5·35 tons of sugar produced per hour total time in 1923-24 and 4·28 tons in 1922-23.

A few comparisons of our figures with data from Hawaii and Java might be of interest.

	Java 1923	Hawaii 1923	Philippines 1924
Cane:			
Per cent. Polarization	13·06	12·78	13·45
,, Fibre	13·14	12·82	11·43
Bagasse:			
Per cent. Polarization	3·75	1·55	3.39
Moisture	46·49	41·56	47·40
Extraction	92·23	97·23	94·04
Press Cake:			
Per cent. Polarization	3·20	2·31	3·71
Loss on 100 Polarization in Cane:			
Bagasse	7·77	2·77	5·96
Press Cake	0·69	0·40	0·45
Molasses (Sucrose)	6·09	7·58	7·52
Undetermined	2·35	0.48	0·40
Total	16·90	11·23	14·33

Of the three countries, it will be seen that the Philippines has the highest per cent. polarization in cane and the lowest fibre. In milling we rank second, also in losses. The average quality ratio in Hawaii for the 1923 crop was 8·573, the actual tons required were 8·556. The average Philippine quality ratio and the actual for the three last crops are as follows:

	Quality Ratio	Tons Cane Required	Difference
1921-22	8·63	9·03	0·40
1922-23	8·04	8·14	0·10
1923-24	8·15	8·36	0·21

As regards the quality of the cane we are better off than Java and Hawaii and the recovery compares favourably with these countries. Now, if we only could compare as favourably in regard to tons cane per hectare! But that is another problem.

Invertase is now being used industrially in the U.S. for the production of invert sugar, the cost of its application being stated as 0·5-1·0 cent per gall. of syrup.

The Cuban Sugar Crop, 1924-25.

From our Havana Correspondent.

The sugar crop of Cuba for the 1924-25 season is now well under way. Two or three factories started up at the end of November, and by the end of December about eighty-two factories were working. In 1923 seventy-six had started by the end of December, and in 1922 fifty-five were reported working. Hence it will be seen that sugar making is further ahead this year than in the two previous ones.

This early start achieved by so many factories is due to the large amount of cane there is to grind. The growing season was such a favourable one, especially at the start when much planting was carried out, and good rains have continued to a late date, so that to-day Cuba has under cane its greatest area and greatest tonnage, and many factories will have all they can do to take off their crops.

The long continued rainy season, however, has had the effect of keeping the cane in a growing state, and we find at the beginning of the crop that the cane is not mature, and that the sucrose content is very low. The weather has been very mild for this season of the year, and cold weather is greatly needed to mature the cane. Should the mild weather continue far into the harvesting season, the sucrose in the cane will increase but slowly, and the yields in the factories will accordingly be affected.

So far reports are that factory yields are very low, and they are likely to continue low for some time; and this fact will have a big influence on the final output of the Cuban factories. Various estimates of the crop have been published, running to between 4,500,000 tons and 4,700,000 tons; the latter figure is about 16 per cent. above the crop of 1923-24.

To increase the sugar crop of a country by 16 per cent. in one year, when the previous crop was a record one in itself, is certainly asking the country to do an almost impossible feat, except under the most favourable conditions of labour, finance, and weather. Therefore we cannot take those high estimates of Cuba's crop seriously, but we do maintain that the present crop will far exceed the past one.

As mentioned above, reports from the factories grinding show a very low yield, and the weather continues too mild to bring about a rapid increase of sucrose in the cane, but notwithstanding that, we know that the tonnage of cane to be harvested this season is very much heavier than that of the previous season. Taking all that into consideration, we would put our estimate of Cuba's crop at 4,300,000 tons of sugar, which is 6·12 per cent. over last year's figures.

There have been strikes of the labourers on several of the factories and plantations. These disturbances were brought about by agitators, mostly Spaniards, and not by the Cuban element. They did not last long, and although there may be a few recurrences in odd spots, we do not expect any large organized strike, and we look forward to the harvesting of the cane and the manufacture of sugar settling down to a normal march, and to all factories working within the next two or three weeks.

8th January, 1925.

The receipts at Cuban ports, according to Guma & Mejer, for the month ending December 31st last amounted to 81,573 long tons, as compared with 32,233 tons in 1923, and 77,778 tons in 1922.

The Sugar Trade in India during the Official Year 1923-24.

By WYNNE SAYER, B.A.,[1] Secretary, Sugar Bureau.

The fall in the import trade of sugar in India witnessed during the year 1922-23 was also observed during the year under review in spite of the fact that the year commenced with light stocks of sugar in India. High prices due to the decreased production of sugar in Cuba, which amounted to only 3,602,910 tons in 1922-23 as compared with the 3,996,387 tons in 1921-22, together with the uncertainty of the markets, caused the merchants to follow a strict hand to mouth policy of purchasing the sugar throughout the year. It should however not be forgotten that the increase in the production of raw sugar (*gur*) in India during the season 1922-23 as compared with the previous season amounted to 420,700 tons with the result that the prices of *gur* were very low during the year 1923-24 when it was available for sale, and thus more *gur* entered into consumption in India where sugar in normal times would have been used.

Gur.—India's production of cane and palm *gur* (raw sugar) during the season 1922-23 (April-March), the major part of which became available for consumption in the earlier part of the year, amounted to 2,953,200 tons against 2,532,500 tons in the previous year, while the quantity of *gur* or jaggery which will be available for consumption and refining during the year 1924-25 amounted to 3,103,000 tons. It will thus be seen that the increase in the production of jaggery amounting to 420,700 tons, combined with the prospect of an equally good crop next season, kept the prices of *gur* very low throughout the year under review and considerably affected the importation of foreign refined sugar in India. India also imported from the countries situated on her borders 622 tons of unrefined sugar, i.e. *gur*, as compared with 524 tons in 1922-23. A very small portion of the total output of *gur* or jaggery is usually exported by sea mostly from Madras Presidency to the United Kingdom, Ceylon and neighbouring countries. The exports of *gur* by sea during the year under review however showed a considerable increase, amounting to not less than 36,325 tons valued at Rs. 85,81,119 as compared with 2479 tons valued at Rs. 5,82,282 during the year 1922-23, which was mostly due to the lower prices of jaggery ruling during the year as compared with other raw sugars offering in foreign markets, principally the United Kingdom. The exports of *gur* by land during the year aggregated only 5513 tons valued at Rs. 12,86,990 against 8730 tons valued at Rs. 28,26,319 last year.

Refined sugar.—Five more modern factories and refineries situated at Bhatni and Unao in the United Provinces, at Pacharukhi and Buxar in Bihar and at Musulipatam in Madras Presidency began to work during the year. Against these additions it must be mentioned that three refineries did not work during the season. India manufactured 74,050 tons of refined sugar in her 31 modern factories and refineries which worked during the season 1922-23. This sugar became available for consumption during the year under review. Although the factories situated in the United Provinces were able to obtain an increased supply of raw material, both cane and *gur*, and were able to turn out a larger quantity of sugar during the season, those situated in Bihar were unable to obtain adequate supplies of cane and the total production of refined sugar in India did not show any increase in spite of the larger area under cane during the season.

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[1] Abridged from the *Indian Trade Journal*, Jan. 1925.

The Sugar Trade in India during the Official Year 1923-24.

As regards India's production of refined sugar by the indigenous process followed by small establishments which are mostly situated in northern India, it should be mentioned that as a result of the low prices of *gur* and *rab*, due to abundant supplies which left ample profits to the manufacturers, an impetus was given for greater production of sugar. It is therefore estimated that not less than 50,000 tons of refined sugar should have been produced from this source as compared with 40,000 tons last year.

We thus arrive at a total approximate production of 124,000 tons of sugar during 1922-23. A portion of this sugar is exported by sea to Asiatic Turkey including Mesopotamia, Persia, Arabia, Ceylon, and Kenya Colony including Zanzibar and Pemba. The exports by sea of both refined and unrefined sugar (not *gur*) to various destinations amounted to 3303 tons, valued at Rs. 9,52,042 as compared with 1022 tons, valued at Rs. 4,42,092.

India's own production of refined sugar is insufficient for her requirements. She has therefore to import from abroad, the main sources of supply being Java, Mauritius and Continental Europe. Java contributed over 90 per cent. of the total imports of sugar and Continental Europe, principally Austria, Hungary, Czecho-Slovakia and Germany, 7 per cent., while the remaining 3 per cent. was divided between Mauritius, China, Egypt, Japan and other countries. Imports from Java including those from the Straits Settlements, which are the forwarding agents of Java sugars, fell from 373,700 tons in 1922-23 to 371,200 tons in the year under review. Out of this Bengal received 154,500 tons, Bombay 99,600 tons, Karachi 87,900 tons, Burma 20,000 tons and Madras 9,200 tons. As regards Mauritius the revival of trade with India noticeable during 1921-22 was short-lived and as a result of the preference accorded to such colonial sugars in the United Kingdom, the quantity of Mauritius sugar imported in India fell from 61,600 tons in 1921-22 to 31,400 tons in 1922-23 while quite an insignificant quantity of 1300 tons was imported during the year under review. Against this, however, may be noted the considerable revival of trade in beet sugar from Continental Europe, no less than 29,680 tons valued at Rs. 1,13,34,936 having been imported during the year, as against 16,593 tons valued at Rs. 67,95,453 last year. With the rapid recovery of the beet sugar industry now taking place in Europe it is anticipated that more and more sugar will be offered to India in the very near future. Out of the total quantity of beet sugar imported in India, Bombay took 21,545 tons, Karachi 7,622 tons, Bengal 500 tons and Madras 13 tons. It is interesting to note that the United States of America which supplied 10,300 tons of sugar during 1922-23, furnished only 200 tons of unrefined sugar i.e., glucose or corn syrup during the year under review.

The table below shows India's imports of sugar during the pre-war year 1913-14 and for the four years 1920-21 to 1923-24.

All these sugars are, however, not consumed within the country but a part is re-exported by sea and land to foreign countries. The re-exports by sea of foreign refined sugar showed a considerable fall in 1923-24 due to the fact that most of the countries which used to get these sugars from India reduced their offtake. This is especially noticed in the case of the United Kingdom, Mesopotamia and Persia. The total re-exports of refined sugar during the year amounted to 35,801 tons valued at Rs. 1,60,67,101 against 62,962 tons valued at Rs. 2,62,35,348 in 1922-23 and 32,595 tons valued at Rs. 1,70,34,496 in 1921-22. It may here be mentioned that the decrease in re-exports of refined sugar amounting to about 27,000 tons partly made good the decrease in the importation of sugar by nearly 31,000 tons during the year under review as compared with the previous year.

Table 1.

Imports of Sugar 16 Dutch Standard and Above and 15 Dutch Standard and Below.

	1913-14 (Pre-war year). Tons.	1920-21. Tons.	1921-22, Tons	1922-23. Tons.	1923-24. Tons.
Java	583,000	201,600	623,300	371,100	368,300
Mauritius	139,600	11,600	61,600	31,400	1,300
Straits Settlements	2,900	9,000	5,100	2,600	2,900
China (including Hongkong)	1,500	5,900	4,400	4,400	5,800
Egypt	100	4,200	200	1,000	700
Japan	100	100	600	100	700
Germany	700	100	100	9,000	5,100
Austria-Hungary	74,000	—	—	—	17,800
Netherlands	—	1,600	2,000	2,900	300
Belgium	—	1,600	12,800	4,900	2,100
United States	—	200	2,800	10,300	200
Other countries	1,100	1,000	4,700	4,700	7,000
Total (all countries)	803,000	236,900	717,600	442,400	411,500
Value (Rs. in lakhs)	14,29	16,99	26,78	14,85	14,78

The stocks at the principal ports of Calcutta, Bombay and Karachi on the 1st April, 1923, amounted to 68,500 tons, while on the 31st March, 1924, they approximated 27,368 tons.

Summarizing the position we find that there were 528,071 tons of white and brown sugar available in India for consumption during the year.

The Sugar Industry in Brazil.

(Department of Overseas Trade Report.)

Pernambuco.—Owing to drought during the growing season the last sugar crop was very much curtailed. It yielded some 165,000 tons of sugar Of this amount 51,069 tons were exported, as follows :—

	Tons
Great Britain	27,709
New York	11,400
Uruguay	6,300
Argentina	2,800
Portugal and Portuguese Islands	2,860
Total	51,069

The balance, apart from a small stock on hand at the end of August, was shipped to Brazilian markets in the usual way.

Of the foregoing foreign exports more than half had been shipped out of the country by the end of 1923, with the result that prices in Pernambuco rose considerably and remained high until May and June, 1924. In July the Federal Government issued a decree removing for 60 days the import duties on foreign sugar, in order to enable cheaper sugar to come into the Rio market; although it is not certain how much of the special allowance of 200,000 bags, or say, 12,000 tons, has come into Rio under this decree, it is believed that at least 3000 tons have arrived from London and New York.

This decree upset the calculations of the Pernambuco planters, who expected to make an early sale to the United Kingdom at the beginning of the coming crop, in order to valorize the balance of their crop. It is felt that the Federal Government does not intend to allow sugar prices to rise to the height they reached last crop, and as Pernambuco, Alagôas, Bahia and Sergipe anticipate larger crops in 1924, owing to plentiful rainfalls, it is expected that exports to foreign markets will only be made when, with increased stocks at exporting centres, local prices reach the level of the New York and London markets.

The profits made by all factories without exception have induced them to improve their plant by purchasing more machinery. Most of the orders have gone to the United States, apparently for the reason that longer credit and quicker delivery were offered. It is expected that, should the rate of exchange improve, more extended orders for new machinery and replacements will be placed.

The coming crop is estimated at between 200,000 and 250,000 tons of sugar, and there is no doubt that fully a fifth of this quantity will have to be exported abroad during the course of the crop, as soon as stocks in the country have become sufficiently large to make any further Government restrictions unnecessary.

Bahia —Only the surplus portion of the sugar crop is exported, prices in the home market being maintained at a level far in excess of world prices Owing to this circumstance, sugar planters and crushers are still enjoying a period of relative prosperity. The new crop is estimated at about 700,000 bags. Practically all the output of the district is handled by one firm, which owns or is interested in several of the largest mills.

American Commerce Reports.[1]

THE SUGAR INDUSTRY IN MEXICO.[2]

The production of sugar in Mexico is probably one of the oldest industries in that country, although its most rapid development was attained in the years between 1900 and 1910, during which time production rose from 75,000 to 100,000 metric tons After 1910, owing to the disturbed condition of the country, production declined until the past few years, when acreage under cultivation in sugar cane was greatly increased and the earlier high level in production has been greatly surpassed. This increase over the 1910 level is a significant sign, since the State of Morelos, once the largest sugar-producing State in Mexico (with a production of 50,000 metric tons in 1910), does not enter into present-day production at all. All of the 26 large mills in Morelos were totally destroyed during the revolution.

It is estimated that the total area in Mexico now under cultivation in sugar cane is about 95,500 acres. Planting is done from July to October, and the grinding season throughout the sugar districts is from December to May, continuing often into the month of June. The majority of the more important Mexican sugar haciendas are owned by companies or corporations which produce and grind their own cane and buy relatively small quantities from other planters. The "central" system, as it is known in Cuba and certain other sugar-producing countries, does not prevail in Mexico, although near some of the large haciendas there are a few planters known as "colonos," who sell their production to the hacienda mill. Most of the large sugar properties are owned by foreigners, Spanish and American capital predominating, while the small sugar properties are owned by Mexicans.

The two largest sugar-producing States in Mexico are Vera Cruz and Sinaloa. The largest company in Mexico is located at Los Mochis, in the State of Sinaloa, and the second largest is at Potrero, in Vera Cruz Both these companies are American concerns.

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[1] Culled from "Commerce Reports," published by the Department of Commerce, Washington. In many cases these are abbreviated here.

[2] Based on report from Assistant Trade Commissioner H. BENTLEY MACKENZIE.

About 80 per cent. of the sugar produced in Mexico is sold within the country. Most of the large producers maintain offices or representatives in Mexico City who sell to brokers, who, in turn, sell to the wholesalers and jobbers. Shipments are made from the mill or from warehouses in various parts of the country to points designated by the representative or by the broker to whom the representative sells.

Sugar from the Sinaloa mills destined for Mexico City and the central Mexican market must be shipped in bond through the United States from Nogales, Ariz., to El Paso, Tex., and from the latter point to Mexico City and other important markets of the central section. Some of the mills secure advances on their sugar from American banks, but to obtain these it is usually necessary to hold all stocks in bonded warehouses in El Paso.

Although Mexico produces more than enough sugar for domestic needs, sugar is imported as well as exported. This is due primarily to price fluctuations in both the domestic and the foreign markets and to the fact that in some districts in the northern central States near the border it is cheaper to import sugar from the United States than from mills in the southern or western parts of Mexico It is also true that a limited demand for refined white sugar on the part of the foreign population of the country and certain of the Mexicans is met with sugar imported from the United States.

Only one mill in Mexico produces a completely refined white sugar, and only a few produce a "plantation white." The greater part of the sugar produced on a commercial scale and entering the export trade is "muscovado," a coarse, brown sugar polarizing at 96°. This grade finds a ready market in Europe, to which destination the larger part of the exports are shipped, and is marketed to some extent in the United States for industrial purposes.

Europe is the largest market for Mexican exports of sugar These exports are usually shipped to dealers in the United Kingdom for transshipment to continental ports. On account of the preferential tariff in favour of Cuban sugar in the United States and owing to the large supply from the noncontiguous territories and the Philippines, Mexican sugar can be sold in the United States only when the market is high These conditions tend to restrict Mexican shipments to U.S.A The refined white sugar produced in Mexico, however, is of high quality and finds a ready sale on the New York market at any time that it is offered.

The Sugar Producers' Chamber of Mexico, an organization comprising about 85 per cent. of the sugar producers in the Republic, has estimated the 1923-24 production of sugar at 170,000 metric tons. Owing to the lower sugar prices in Europe and the United States during the past season, the volume of sugar exportation from Mexico declined. It is not believed, however, that sugar stocks at the end of the present sugar season (about the middle of December) will be large.

The average annual production of molasses in Mexico is about 75,000 metric tons. Most of the molasses is produced within the States of Puebla, Vera Cruz, and Sinaloa, the remainder of the production being scattered throughout the Republic. There is usually available for export from 5,000 to 10,000 tons of the total amount produced, most of which is available for shipment from the mills of Vera Cruz and Sinaloa. Most of the production at the present time is retained within the country to be worked up into alcohol by the sugar-mill owners or by producers of alcohol.

MOLASSES SUPPLY OF THE NETHERLANDS.

Among the agricultural products raised in the Netherlands, sugar beets have always played a significant rôle. The acreage devoted to this culture ranks third, being surpassed only by the areas devoted to the growing of oats and rye. In 1923 the area planted to sugar beets was 67,497 hectares, compared with 60,300 hectares in 1913.

Local consumption of molasses in the Netherlands may be estimated at 2000 to 4000 tons a year. Molasses is a by-product which brings a very poor price on the Dutch market, owing to the limitations of the market. It is sold as cattle feed, although the abundance of pastures in the country limits that use. It is used to some extent for distilling purposes in order to obtain yeast and wood alcohol, and is used at times by special factories which extract its sugar by chemical processes. This was done in 1923 when sugar prices were high enough to justify the expenditure required.

The exportable surplus of molasses may be roughly estimated at 60,000 metric tons a year. Prior to 1923, Belgium, Austria, and Germany were the principal destinations for the molasses exports from the Netherlands, while during 1923 and 1924 practically the entire quantity was shipped to the United States.

The exportation is handled entirely by one large company near Rotterdam, which takes care of all business pertaining to the sale and shipment of this product.

This central sales organization in Delft, near Rotterdam, handles the business in a most efficient and practical manner. The product is sold and shipped direct to a large company in Liverpool, which sells to the United States, c.i f. American port. No extra profit or added commission is made by the Liverpool company, its share in the transaction being limited to transportation charges. A fleet of tank ships operates regularly between Europe and the United States, taking molasses to the United States or bringing back lower grades of the product to be used in England for cattle feed. A sample of every shipment of molasses is sent by the Dutch company to the purchaser in the United States in order that a check may be made upon the quality and grade upon the arrival of the total shipment. The terms of payment are ex-factory, payment upon shipment from factory, irrevocable credit to be established at a Netherlands bank.

British Sugar Subsidy.

Proposed Rate according to Polarization.

Article	Rate per Cwt					
	If Manufactured between 30th Sept, 1921, and 1st Oct, 1928.		If Manufactured between 30th Sept, 1928, and 1st Oct, 1931		If Manufact'd between 30th Sept, 1931, and 1st Oct, 1934.	
	s.	d	s.	d	s	d.
Sugar which when tested by the polariscope indicates a polarization exceeding 98°	19	6 0	13	0 0	6	6·0
Sugar of a polarization—						
Exceeding 97 and not exceeding 98	17	11·2	11	11·5	5	11·7
,, 96 ,, 97	17	5 6	11	7·7	5	9.8
,, 95 ,, 96	17	0 0	11	4·0	5	8·0
,, 94 ,, 95	16	6 4	11	0·2	5	6·1
,, 93 ,, 94	16	0 8	10	8·5	5	4·2
,, 92 ,, 93	15	7·2	10	4 8	5	2·4
,, 91 ,, 92	15	1·5	10	1 0	5	0·5
,, 90 ,, 91	14	7·9	9	9·3	4	10·6
,, 89 ,, 90	14	2·3	9	5·5	4	8·7
,, 88 ,, 89	13	8 7	9	1·8	4	6·9
,, 87 ,, 88	13	4·0	8	10·7	4	5·3
,, 86 ,, 87	12	11 3	8	7·5	4	3·7
,, 85 ,, 86	12	7·1	8	4·7	4	2·3
,, 84 ,, 85	12	2·9	8	1·9	4	0·9
,, 83 ,, 84	11	10·7	7	11·1	3	11·5
,, 82 ,, 83	11	6·5	7	8·3	3	10·1
,, 81 ,, 82	11	2 7	7	5·8	3	8·9
,, 80 ,, 81	10	11·0	7	3 3	3	7·6
,, 79 ,, 80	10	7 2	7	0·8	3	6·4
,, 78 ,, 79	10	3·5	6	10·3	3	5·1
,, 77 ,, 78	9	11·8	6	7·8	3	3·9
,, 76 ,, 77	9	8·0	6	5·3	3	2·6

Review of Current Technical Literature.[1]

PLANT ARRANGEMENT FOR A PHILIPPINE FACTORY. *Herbert Walker and E. W. Kopke. Report made to the Second Annual Convention of the Philippine Sugar Association, 1924.*

An improved general arrangement for the equipment of a 2000 ton sugar factory, an attempt to combine the features proved to be most satisfactory for Philippine conditions is here suggested. It provides a compact lay-out with provision for future extensions without interfering with the original installation even while the factory is in operation. Some of the main points of deviation from older designs are: *Cane unloader.*—The railroad line bringing cane to the mill is at right angles to the usual arrangement. The straight line movement of trains eliminates the usual switching and offset arrangement of the track after leaving the cane carrier. The Cuban style of dumping old cars on to a cross conveyor requires fewer men for its operation. *Mill.*—Provision is made for installing another unit alongside the first one. *Boilers.*—These are enclosed in a separate house directly in line with, and back of, the mill. Future extensions may be in line with another mill installation or may be a continuation along the line of the original installation. *Generators.*—These are likewise in a separate building. *Steam lines*—The main live steam lines pass directly to the generator house and continue directly in line with the mill engines, but a fraction of the usual piping being required. Similarly the exhaust steam from the turbine enters a main directly adjacent to the live steam line, connects with the exhaust line from the mill engines and from there connects directly to the boiling house. *Boiling house.*—The scales, comprising two juice scales, a maceration water scale, and a molasses scale, are mounted in one battery between the mill and the boiling house. Mixed juice is limed at the scale station and delivered through the heaters, which should be located closer to the clarification system Space is provided behind the evaporators for either continuous or intermittent settling tanks, and back of the clarifiers for a battery of filter-presses along the whole side of the building directly back of the clarifiers. This arrangement involves the least amount of piping from one apparatus to the other and permits of one person supervising all these operations with very little moving around. Directly in front of the evaporators is a large open space, which enables the boiling-house foreman to keep watch over the centrifugals and sugar handling, and also provides light for the centrifugals below. The vacuum pans are located in a straight line directly across from, and parallel to, the evaporators. Syrup and molasses supply tanks are directly back of the pans The centrifugals for "A" sugar are directly under the pans, while the low-grade massecuite, instead of discharging to the crystallizers through a long flume, drops directly to a receiver the size of the pan, from which it is pumped to the crystallizers either by a magma pump or by compressed air. If desired, a portion of the low-grade magma may be returned from the receiver to the pan floor for use as "seed." Locating the crystallizers on the ground floor makes it possible to instal a cooling device above them and remove a large amount of heat from the massecuite before the final crystallization. This arrangement has been followed in the new Bacolod-Murcia extension as far as the local conditions permit. The principles involved are applicable for practically any range of requirements or capacities.

(*A*) STEAM MACERATION. (*B*) DEEPENING JUICE-GROOVES OF MILL ROLLERS. *Theo. Nickelsen. Sugar News, 1924, 5, 280–281.*

(*A*) A 1 in steam pipe perforated with $\frac{1}{16}$ in. holes, spaced ½ in. apart, was clamped along the scrapers of the discharge roller of No. 1 and No. 2 Mills at Mindoro, with the perforations inclined vertically at an angle of about 30°, the direction of perforations being towards the moving bagasse. Immediately behind this pipe, a cold water maceration pipe was installed, also lying along the scraper, with ⅛ in. perforations pointing vertically up to the moving mass of bagasse. Directly over the pipe a cold water-bath was suspended so as to overflow over the bagasse just behind the point of steam impact upon the blanket. On taking milling data after the installation of this device for applying steam, it was found that the sucrose in the final bagasse was always lower as compared with ordinary water maceration. This may be explained by the action of the steam in opening up the uncrushed cells and fibres of bagasse, whilst the immediate application of cold water insured a perfect mixture. Hot water was tried with steam, but the resulting high temperature of the bagasse caused rollers, headstocks, etc., to get so hot that it was not advisable to so run. Cold water or medium hot water gave good results.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

(*B*) On studying the action of expressing the juice by the mill rollers, it would seem that the best results obtainable would be when there is no reversing of the direction of the flow of expressed juice. This means that at the point where the feed-roller and top-roller unite in expressing the juice, the juice, instead of flowing ahead of the material coming up behind to be crushed, backs up, so that part of it must be reabsorbed by the oncoming dry cane or bagasse. Before the advent of the drainage juice-groove this re-absorption was serious, for undoubtedly a certain part of this supersaturated compress slipped by the feed and top roll, and additional work was piled on the bagasse or discharge roll. Part of this problem in milling has been overcome by the Messchaert drainage grooves, but we still have the reverse flow of the juice, both of the feed roller and at the point of contact of the top and discharge roll. Experimenting along these lines, the writer found that by deepening the juice-groove to 2 or 3 in., the juice would flow forward under the returner-bar toe and drop to the juice pan, and, at the conjunction of the top and bagasse roll, would drop straight down with less interference from the packed bagasse in the grooves The reason for the flowing forward of the juice is that, the groove being deeper, the bagasse never reaches the bottom, and, as a whole, is packed looser, giving greater freedom for the liberation and discharge of the juice Moreover, the wear of the returner-bar toe is not so great as to allow fingers of sufficient length to form and plug the groove, which happens with the shallow 1¼ in or 1½ in depth groove.

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NOTES ON EVAPORATING, BOILING, AND CURING MACHINERY. *William Gibb.* *Report made to the Second Annual Convention of the Philippine Sugar Association, 1924*

Evaporators.—Muriatic acid and soda ash or caustic soda may keep the evaporator sufficiently clean provided its capacity is fairly liberal, otherwise scraping by hand, air or water power, will have to be resorted to. If the bottoms of the evaporators are not opened frequently, and the work of cleaning supervised from both ends, the labourers get in the habit of pushing the brush or scraper only part way down. Bolted-on man-hole covers for the bottoms often have a cone that projects inside to help the circulation but this is of less value to the speed and efficiency of the apparatus than absolute cleanliness in one's estimation. So one would advocate the readily opened, old fashioned, hinged man-hole door. Next to dirt on the tubes comes poor drainage of condensate for retarding speed, for the removal of which it seems to be almost universal practice to provide too small a pump. If there is sufficient height from the evaporator floor to the ground floor gravity drainage can be used to good advantage. Another important thing is not to carry much liquor at a time, which fault is as often with the designer as the operator. It may not be good practice to have the bull's eye or sight glass too close to the edge of the belt, thereby rendering the belt weak at the joint, but it is not necessary to have it a foot or more above the calandria especially in evaporators of small diameter. Two sight glasses in front and one behind should be provided and these not too high above the calandria in order that the best results may be obtained. Automatic regulators or levellers are not always reliable, and this makes the proper position of the glasses very important. It is impossible to teach any operator of any nationality to run a standard type of evaporator if the juice is where he cannot easily see it. Too free access of juice may cause entrainment. The juice inlets should have fairly wide plates over them, or if the circular juice distributors are used the holes should be on the lower side in the last cell; the other cells never seem to give any trouble. If the staggered tube type of save-all is used, it must be kept clean or the extra speed attained by the vapour in forcing its way through the constricted opening will carry much juice along with it. *Vacuum pans.*—Like evaporators, pans are most efficient when simplicity of design is strictly adhered to Some have cone discharge valves instead of sliding gates; the stems of the cone valves extending up through the top of the dome. This necessitates two openings where one would otherwise suffice; and too many openings do not help in maintaining a high vacuum. This style of outlet also requires a ring of packing inserted above the valve on the lower edge of the pan bottom. The massecuite on being discharged has a tendency to loosen this packing, thus causing much delay in replacing it. Air leaks result from the same cause. Theoretically, the cone is supposed to help circulation, but for some reason or other the pans thus equipped in the P.I. industry have the poorest circulation of any in use. So far, the plain sliding gate is by far superior. There are also some pans in the P.I. provided with cast-iron tube sheets and copper tubes This is a type to be avoided. The two metals do not expand uniformly when heated and this makes it almost impossible to keep the tubes from becoming loose and allowing steam to leak into the massecuite when operating. Since water obtainable for condensation purposes is higher in temperature than that in some other sugar producing countries, the condensers should be of generous proportions Some of the local factories have a double condensation system. This gives splendid results. *Crystallizers.*—There is no crystallizer in general use to-day that cools the massecuite fast enough to obtain the best results. *Centrifugals.*—These are practically all of standard sizes and shapes. In so far as drying "A" sugar is concerned, the most important thing is speed, for if the machines cannot be run up to their rated speeds, too much moisture is left in the sugar. For the drying of "B" sugar care should be taken to select a make of centrifugal that has no flare either top or bottom. If the tops and bottoms are not at right angles to the sides or nearly so, the screens slip out of position and massecuite pushes over the upper edge of the screen. This loss may be checked somewhat by stretching a strip of sacking around the edges of the screen. This is by no means a sure cure, as the tendency to slip depends on the amount of slope on the bottom It also leaves a portion of each charge very poorly dried

PRACTICAL METHODS OF CONTROLLING THE COMPOSITION OF BAGASSE

E. Haddon.

Communication to this Journal, received November, 1924.

The determination of sucrose in bagasse as generally done is liable to error. Bagasse is of an unequal composition due to the structure of the cane, to the unequal mixing of the added water, and to the inferior crushing at the ends of the rollers Moreover, where mechanical feed (derricks) has replaced hand feed, the pressure of each unit is found to vary continually, the sucrose in the bagasse following the same oscillations, so that it is nearly impossible to get a fair sample. If two inaccurate samples are taken, the average composition found may be untrue. In order to be able to check the sucrose content of the bagasse, the author has taken a sample continually of the macerated bagasse entering the last mill, pressed it in the laboratory mill to about the same moisture as that of the factory bagasse, and analysed both the expressed juice and the remaining bagasse. He has always found a constant relation between the sucrose in the juice and the sucrose in the bagasse, the sucrose in 100 of bagasse being equal to about 90 per cent. of that of the juice. This factor cannot be applied to all factories, but should be daily determined. The sampling of the last mill juice is simple, and its sucrose content is easier to determine than that of the bagasse. The chemical control data for Hawaii of 1921 show a factor of 0·89,[1] whilst those for the Philippine Centrals of 1922 one of 0.88.[2] Another way of checking the composition of a bagasse is to calculate the amount of maceration water which remains in it. For this determination one must assume the following factors: Brix of normal juice = Brix of 1st mill juice × 0·975; Brix of residual juice = Brix of normal juice × 0·990; colloid water of fibre = 30 per cent.; and added water remaining in bagasse = 3 Let us take for example the chemical control data for Java for 1923.[3]

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[1] *I.S.J.*, 1922, 194. [2] *I.S.J.*, 1924, 100. [3] *I.S.J.*, 1924, 364.

Composition of the cane: Sucrose, 13·06; non-sucrose, 2 57; dry fibre, 13·14; colloid water, 3·94; water of juice, 67·49; and purity of juice, 84.6. Brix of normal juice: $\frac{15\ 43}{82{\cdot}92} \times 100 = 18{\cdot}60$. Brix of residual juice: $18{\cdot}60 \times 0{\cdot}990 = 18{\cdot}41$. *Composition of the bagasse*: Sucrose, 1·02; non-sucrose, 0·25; dry fibre, 13·14, colloid water, 3·94; water, 8·85–a total of 27·20. Purity of the last mill juice, 80. *Diluted residual juice*: Sucrose, 1·02; non-sucrose, 0·25; and water, 8 85—a total of 10·12 As the residual juice should have a Brix of 18·41, it follows that the quantity of undiluted residual juice is $\frac{100}{18\ 41} \times 1\ 27 = 6{\cdot}89$. Therefore, the added water remaining in the bagasse is: $10\ 12 - 6{\cdot}89 = 3{\cdot}23$. From the chemical control data of Hawaii for 1921 this water content is found to be 3 16, whilst from those of the Philippine Centrals for 1922-23 it is 3·05.

PROPOSED METHOD OF WEIGHING AND SAMPLING THE CANE AND JUICE OF THE INDIVIDUAL PLANTER *F. T. Rosado*. *Report of the Committee on Chemical Control, presented to the Second Annual Convention, Philippine Sugar Association, 1924.*

As a means of obviating the present dissatisfaction of the planter in the P.I., who demands more piculs of sugar per ton of cane than his next-door neighbour regardless of the quality of his juice, and suspects the accuracy of the sampling, or the identity of the sample, or the trash deduction, the following scheme is proposed· (1) Provide every cane car with pocket for ticket This ticket may be in the form of cardboard, 1½ in. × 3 in., on which the date, number of the car, owner or *hacienda's* name are written, and possibly the number of the field, and whether plant or ratoon cane is being delivered. This card is placed in the car pocket by the *hacienda capatas*; and when the locomotive arrives to haul these loaded cars to the mill, the train conductor issues a receipt stating the number of cars in a book provided for this purpose after ascertaining, of course, that all data called for on the card are properly supplied. This receipt will serve to identify the car in case a car does not reach the scale, due to derailment along the road or for any other reason. (2) When these cars arrive at the mill yard, the yard inspector goes over them, takes out each ticket from the pocket, checks up the number of the car against that in the ticket, enters this number in a small book with detachable leaves, making a carbon copy. He enters on one sheet the numbers of all cars that belong to one planter; the planter's name, however, is omitted Then he turns in this new list to the scale-man who in turn takes down these numbers in his regular book provided for that purpose. As soon as the first car comes upon the scale, the cane weigher signals to the sample boy, to whom he gives the original list of the yard inspector. (3) The sample boy watches for the first car; and, when it passes through the crusher, starts taking the sample and continues sampling until the last car has gone through. The sample boy takes out his bucket, attaches the list to it, and sends it to the laboratory for analysis. (4) The analyser writes down in this list the analysis of the juice. In this way, the cane is weighed and the juice sampled and analysed without either the cane weigher, juice sampler or analyser ever knowing to whom the cane belonged. (5) Every six hours or so, all these unidentified tickets with their analysis are turned over to the clerks, one representing the Central and the other the Planters' Association, who segregate these analyses by identifying them from the cardboard ticket turned in by the yard inspector. This work can be done in a few hours so that a few minutes after the end of the twenty four hour run, the total weight of the cane together with the average analysis of each planter would be ready for the daily mill report which must be submitted by 9 or 10 a.m. It is hoped that this scheme will do away with many unreasonable complaints brought into the office of the chemist. In regard to the actual method of chemical control, the Hawaiian method of procedure[1] with slight modifications has been unanimously adopted since the establishment of the centrifugal sugar industry here. These modifications are the following: (1) Sugar distribution to planters. It would be necessary to adopt a common system for distributing sugar to the planters. (2) Molasses distribution table. Preferably to be expressed in terms of gallons per ton of sugar or cane. (3) A detailed explanation of normal juice factor and how obtained. (4) Stock report to be in metric system. (5) Added definitions to be given in regard to (a) tonnage fibre ratio for central equipped with double mills, (b) clarity and excess moisture. Also the mill time distribution should be clearly defined, especially in the case of double mills. (6) Definition of molasses produced (as some factories report molasses discarded only). (7) Definition and standardization of percentage fibre in cane to be reported. Many sugar-house laboratories report percentage of fibre in clean cane only, thus introducing two errors in the daily report, namely · (*a*) calculated amount of bagasse is too low, and (*b*) the milling department is credited with too high extraction. (8) Standardizing analysis of waste molasses for true sucrose; also dilution for reading Brix.

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[1] *I S.J.*, 1924, 551.

EXTRACTION OF SUGAR FROM BEET MOLASSES BY THE FRIEDRICH AND RAJTORA PROCESS. *V. Rajtora. Zeitsch. Zuckerind. Czecho-Slov., 1925, 49, No 13, 100-104.*

Dr. RAJTORA given some details of the carrying out of his process of desaccharifying molasses by the addition of acetic acid[1] Concentration should be carried to at least 90° Brix., though, if possible, it is better continued to 95°, whilst it is also advantageous to add a little benzol, about 0 2 per cent, this lowering considerably the viscosity. Ordinary centrifugals can be used for the separation of the fine grain which separates out as the result of acidification, these being provided with specially fine screens, although when the crystals are particularly fine, it is necessary to use cloth (preferably jute) An acid, "quite white" sugar is obtained from molasses by this process, and its most suitable outlet is in industries (as those of jam and confectionery) in which an inverted product can be used. A yield of about 95 per cent has been realized it is stated by the Friedrich and Rajtora process. It is admitted that its economy depends on the efficiency with which the acetic acid may be recovered from the treated liquors, and that after this recovery the waste liquors should be treated for the utilization of their potash and nitrogen content. A balance-sheet showing a very favourable profit is presented by the author.

RÔLE OF NITROGENOUS NON-SUGARS IN BEET SUGAR MANUFACTURE. *W. Taegener Centralblatt fur die Zuckerindustrie, 1924, 32, 852-855* REVIEW OF PROGRESS IN FUEL TECHNOLOGY *R. T. Haslam and E. W. Thiele. La Planter, 1924, 73, No 10, 190-193.* CENTRIFUGAL AND ROTARY PUMPS IN BEET SUGAR FACTORIES. *Felix Langen Centr. Zuckerind, 1924, 32, 897-899, 921-925, 945-949.* INDUSTRIAL PRODUCTION OF CRYSTALS. *T V. Barker. The Chemical Age, 1924, 442. Hugh Griffiths, Ibid., 1924, 442-444* REPORT ON THE DETERMINATION OF ARSENIC. *R. M. Hann. Journal of the Association of Official Agricultural Chemists, 1924, 8, No. 2, 121-123* REPORT ON PECTIN IN FRUITS AND FRUIT PRODUCTS. *H. J. Wichmann. Ibid., 123-130.* REPORT ON CACAO PRODUCTS. *V. A. Pease and E. R. Miller. Ibid, 176-182* DETERMINATION OF THE HYDROGEN-ION CONCENTRATION OF SUGAR FACTORY PRODUCTS, ELECTRO METRICALLY. *A. H W. Aten and P. J. H. van Ginnekin. Tydschrift, 1924, No 5, 89-112* TENDENCIES IN THE ELECTRIFICATION OF CUBAN SUGAR MILLS. *C A. Kelsey. La. Planter, 72, No. 20, 392-393* A PRACTICAL BEET HARVESTER (J. F. FANGERS). *Anon. Facts about Sugar, 1924, 18, No. 26, 612* DATA REGARDING THE EQUIPMENT OF CENTRAL UFIÑGA (BRAZIL). *Anon. Ibid, 1924, 19, No. 12, 273-274.* OSMOSE PROCESS (FUCHS SYSTEM) EXAMINED. *Ludwig Fuchs. Zeitsch. Zuckerind Czecho-Slov., 1924, 48, 224-228* A METHOD FOR THE MANUFACTURE OF LEVULOSE *R. F. Jackson, C. G. Silsbee, and M. J. Proffitt. Industrial and Engineering Chemistry, 1924, 16, No. 12, 1250-1251.*

J. P O

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[1] *I.S.J.*, 1924, 557, 666.

Review of Recent Patents.[1]

UNITED KINGDOM.

Juice Extraction by Milling, the Bagasse after Maceration being immediately Re-compressed. *Angel Maria Burunat*, of Ingenio Isabel, Cuba. *225,449* April 8th, 1924.

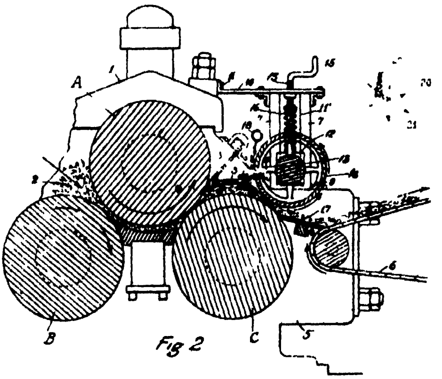

Fig 2

As it leaves the mill, the bagasse is treated as usual with maceration water, but immediately afterwards the wet layer is compressed In the drawings is shown a mill furnished with three rollers *A*, *B* and *C*, a hydraulic pressure cap *1* bears upon the top roller, which latter is spaced from the two lower rollers to form an entrance *2* for the bagasse. On the opposite side of the upper roller is a scraper blade *3*. A supporting frame is provided comprising two standards *7* and *8* fixed at the bottom by screws *9* to the lower part of the mill frame and joined at the top by a plate *10*, which is fixed with screws *11* with respect to the top part of the said mill frame. The standards *7* and *8* are provided with vertical guides *11*¹ in which are slidable the bearings *12* of a horizontal axle *13* to which is fixed a roller *14*, the length of the said roller being proportionate to the roller, leaving a clearance with regard to the roller *C*. This clearance is regulated by means of screws *15*, each provided with a handle *15*¹, there being a screw at each end of the roller passing through the plate *10* and resting on springs *16*. The lower ends of the springs are fixed to each bearing *12* of the roller *14*, thus providing a resilient wall to the exit between roller *14* and the bottom roller *C*, and also enabling the space between the roller *14* and the roller *C* to be adjusted This arrangement may be varied without changing the scope of the invention For example, the bearings may be fixed and placed at a convenient height. Furthermore, the rotation of the roller *14* may be effected from any source of adequate power The direction of the rotation of the roller *14* is the same precisely as that in the top roller *A*. The scraper blade *3* has an extension or ear *3*¹ toward the roller *14*, which extension serves as a guide for the layer of bagasse *17* when the latter comes out from between the rollers *A* and *C*, thus preventing the bagasse from unduly expanding after its compression between the rollers of the said mill. The bagasse now receives the maceration water and immediately undergoes the compressive action of the roller *14*. Consequently, its thickness is considerably reduced, forming a more compact layer prepared to receive efficiently the action of the next mill. Between the scraper blade and roller *14*, there is a horizontal pipe *18* provided with the usual spraying holes for maceration water. A guide plate *19* is provided to support the layer of cane between the roller *C* and the belt *6*, which latter carries the cane toward the other set of mills One of the inconveniences met with up to the present is that the maceration water on falling over the layer of bagasse as this comes out of the rollers does not penetrate the entire thickness of the bagasse but only a portion of the same. According to the present invention the layer of bagasse *17*, as it comes out from between the rollers *A* and *C* first receives the water that is sprayed from the pipe *18* and is then compressed by the roller *14*, with the result that the water penetrates into the entire thickness of the layer whilst the latter is being compressed. The layer thus remains completely wet and is reduced in thickness on coming out from between the drum *14* and the bottom roller *C* to be carried away by the belt *6*. Maceration is thus carried out with greater efficiency. Adjacent to Fig. 2, is shown diagrammatically and in dotted lines two rollers *20*, *21* between which the bagasse passes after receiving the maceration water from nozzle *22*.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C 2 (price, 1s each) *United States:* Commissioner of Patents, Washington, D.C (price 10 cents each). *France:* L'Imprimerie Nationale 87, rue Vieille du Temple, Paris.

Alcohol Motor Fuels. (*A*) ***Benj. H. Morgan,*** of Westminster, London. *219,903.* March 27th, 1924. (*B*) ***E. H. Records,*** of Wallace, Idaho, U.S.A. *223,140.* March 24th, 1924. (*C*) ***F. Hostettler*** (Assignee of ***J. Dolfen***). *174,360* ; and *176,329.* January 20th, 1922; convention dates, January 24th, 1921, and March 1st, 1921. (*D*) ***A. E. White, (General Motors Research Corporation,*** of Dayton, Ohio, U.S.A.) *224,102* December 1st, 1923. (*E*) ***G. Kraitzschier,*** of Teplitz, Czecho-Slovakia. *223,604.* October 20th, 1924; convention date, October 18th, 1923.

(*A*) Motor spirit comprises a mixture of up to 60 per cent. by weight of gas oil, solar oil, fuel oil, or other petroleum fraction heavier than kerosene, with 40 per cent. or more of a liquid consisting of 60–70 parts by weight of denatured alcohol, 40–30 parts of ether, and a little castor oil [1] (*B*) Motor spirit consists of a mixture of 815 pints of alcohol, 100 pints of benzol, 50 pints of ether, and 35 pints of naphthalene (*C*) Motor spirit consists of a mixture of tar oil, a mineral oil distillate, and an oxygen carrier, such as wood spirit or petroleum spirit Aliphatic, aromatic or hydro-aromatic ketones, aldehydes, ethers, or esters are used instead of, or together with, the wood spirit. (*D*) Hydrocarbon motor fuels, e.g., kerosene or gasolene, have their critical compression pressure raised by the addition as an "anti-knock compound" of a small proportion of an alkyl or aryl compound of lead and of a halide or other chemical which during combustion forms with the lead end-products having less fusing or fluxing action with the metal or porcelain parts of the engine than has lead oxide In an example, 2 grms. of carbon tetrachloride are mixed with 3 grms. of lead tetra ethyl or methyl, and 5 c.c. of the mixture is added to 1 gall. of gasolene or kerosene. Benzol and an alcohol miscible in all proportions with paraffin hydrocarbons may be added to assist in blending. (*E*) Motor spirit consists of benzene, benzol, or other liquid hydrocarbon, and non-acid substances containing oxygen. Specified substances are "amyl," "methyl," eucalyptus oil and similar oils, and alcohols and ketones of the turpentine group.

Production of Active (Decolorizing) Carbon. ***Ges. für Chemische Produktion H. Müller-Clemm, and I. Schmidt,*** all of Waldhof, Mannheim, Germany. *224,521.* October 22nd, 1924, convention date, November 5th, 1924.

An active charcoal suitable for decolorizing purposes is produced by heating wood, cork, or similar vegetable material to incandescence in the absence of air after impregnation with liver of sulphur or a solution of potassium sulphide or polysulphide. The vegetable material may be reduced to granular form and after the heat treatment suddenly cooled with water, leached, and, if desired, treated with hydrochloric acid. The finely powdered portion as well as the granular portion of the product is highly active. The solution of potassium sulphide and carbonate resulting on leaching is used for activating fresh material.

Distillation and Rectification of Alcoholic Liquids. ***E A. Barbet,*** of Paris, *224,921.* November 17th, 1924; convention date, November 17th, 1923.

In rectifying alcohol, the proportion of water in the distillery is decreased by conducting the rectification under reduced pressure, when, at an absolute pressure of 70 mm., alcohol free from water is obtained.

Beet Thinning Machine. ***M. Andersen,*** of Copenhagen, Denmark. *223,964.* July 1923.

A hoe is moved transversely to break up the line of beets into separated clumps, and one plant in each clump is then isolated, the remaining plants being pulled out between gripping arms.

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[1] Compare U.K. Patent, 189,715; *I.S.J.*, 1923, 219.

UNITED STATES.

DISTILLATION OF ALCOHOL. *(A) John P. Foster,* of Maui, T. H. *1,505,634.* August 19th, 1924. *(B) James F. Cyphers,* of Baltimore, Maryland, U.S.A. *1,507,108.* September 2nd, 1924.

(A) In the patent recently issued to the inventor and A. F. MISSNER,[1] a continuous distilling apparatus is described, and the present invention is particularly adapted to be used with this apparatus, though it can also be applied with advantage in discontinuously operating stills Briefly, it provides means whereby the "beer" entering the "pot" (or heating chamber) is finely subdivided to be more readily heated. This pot is formed by a tub-like receptacle or tank closed at the top and bottom. In its lower part is a perforated heating coil connected with a pipe from a suitable source of steam pressure. An overflow pipe leads from the pot to maintain a constant level of the liquid therein, and in this pipe is a loop to form a liquid-seal to prevent the escape of vapour. In the upper part of the pot is an annular trough with serrated edges into which lead a pipe from a pump communicating through a branched pipe with the lower part of the pot. With the pot filled with liquid to the level of the constant pipe, the pump in action will send the liquid from the pot into the trough over the edge of which it flows to the lower part of the pot again. In this way a constant circulation of the liquid through the pot is maintained contrawise to the flow of the vapour, and the pipe having branches communicating with the pot at different levels insures the circulation of the entire liquid content of the pot. Thus, the said annular trough and the said baffle successively operate to subdivide and distribute the liquid to commingle it with the rising vapour.

(B) In ordinary rectification the impurities having a higher b. pt. than ethyl alcohol are separated by successive distillations in the "high boilers" or "tails"; whilst the others having a lower b. pt. are similarly removed in the "low boilers" or "heads." But it is the object of the present invention to carry on the successive distillations simultaneously, to concentrate the various impurities and to remove them from the alcohol at the points of their concentration, and to conserve the heat to the utmost. It is accomplished by heating the crude alcoholic liquors by alcoholic vapours and then by the exhausted liquors, the alcoholic liquors being passed into the middle of the rectifying still, in which advancing alcoholic vapours progressively becoming more pure are brought into contact with descending exhausted liquors, progressively becoming more exhausted. This process is repeated with alcohol vapours being brought into similar contact with high boiling impurities, then vaporous low boiling impurities being brought into similar contact with liquid alcohol, the final alcohol being nearly pure and the amount of alcohol lost in removing the impurities being reduced to a minimum.

ACTIVATION OF CARBON (KILN FOR THE PRODUCTION OF DECOLORIZING CARBON). *John C. Woodruff and Thorne L. Wheeler,* of New York, U.S.A. *1,505,517* August 19th, 1924.

Heretofore, charcoal has been activated by means of steam in vertical tube furnaces called "Dorsite" treaters; but the highest quality of absorbent charcoal is obtained only by running the material at a very slow rate, or by re-running it several times through this type of furnace. This process requires a large amount of time and fuel; whilst difficulty is experienced in feeding due to the formation of gas pockets which hold the charcoal from sliding after material is discharged from the bottom. These defects (and others) are, however, overcome in the present invention. It consists of a process of increasing the adsorptive power of carbon by oxidation, which comprises agitating the carbon in an elongated heated reaction zone, and distributing steam (or other active oxidizing agent) throughout the reaction zone so that all of the carbon therein is simultaneously subjected to the action of the steam (or other vapour) before the latter is materially contaminated by the end products of the reaction, the carbon being maintained during the reaction at a temperature sufficiently high to ensure rapid activation by the external application of heated combustion products

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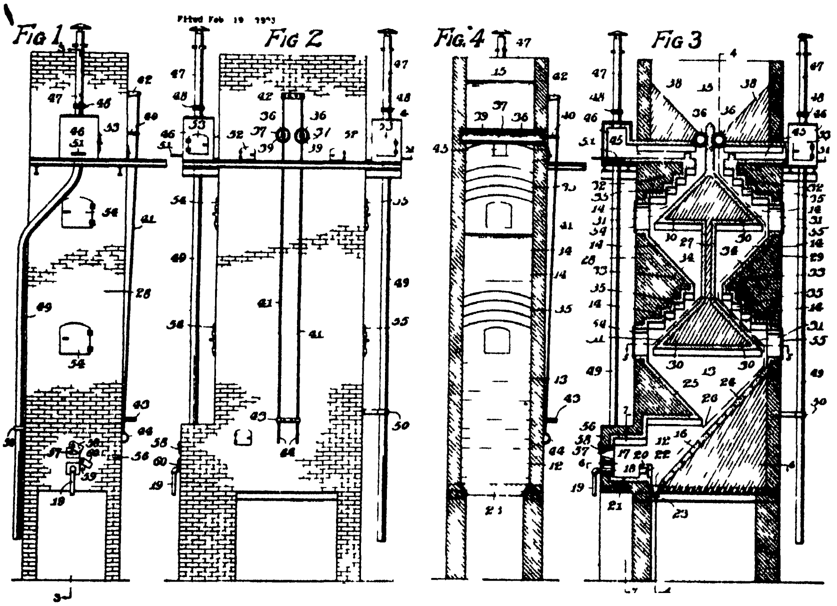
[1] U.S. Patent, 1,466,221; *I S J.*, 1924, 340,

Kiln for burning [or revivifying] Animal Charcoal [Boneblack], Fuller's Earth, etc. *Jacob Norbeck*, of Philadelphia. *1,490,846*. April 15th, 1924.

Referring to the drawings, the body of the furnace is formed of suitable brick-work which encloses a combustion chamber *12* in the lower portion thereof, a heating chamber *13* above the combustion chamber *12*, two sets of separate heating passages *14*, extending upwardly from the chamber *13*, and a hopper *15* above the passages *14* The back wall *16* of the combustion and heating chambers *12* and *13* is inclined rearwardly and upwardly, as clearly shown in Fig. 3. Opening into the forward portion *17* of the combustion chamber *12* near the bottom thereof is a fuel burner *18* which is directed toward the back wall *16*. The burner *18* is supplied with gas or other suitable fuel through a pipe *19* connected thereto. Interposed between the burner *18* and the back wall *16* is a baffle wall *20*, which extends upwardly from the bottom *21* a short distance in spaced relation to the burner *18* and back wall *16*. The wall *20* is formed of suitable brick work and it is provided with scattered openings *22* extending horizontally therethrough for the passage of flame from the burner. The wall *20* acts as a baffle for the flame to distribute it over the combustion chamber *12* and over an extended area of the inclined back wall *16*. The bottom of the furnace is provided with a narrow vertical passage *23* disposed between the back wall *16* and the baffle wall *20*, through which the burnt material may discharge. The inclined back wall *16* of the chamber *12* extends rearwardly and upwardly and forms one side of the bottom of the heating chamber *13*. The other side of the bottom of the heating chamber *13* is formed by an inwardly extending wall *25* which also forms the top of the combustion chamber *12*. The upper surfaces of the walls *16* and *25* of the heating chamber *13* converge toward the bottom of the same, and the wall *25* terminates before meeting the wall *16*, providing an opening or passage *26* through which the burnt material may pass from the heating chamber *13* into the combustion chamber *12*. The two sets of passages *14* are formed between a central wall *27* and outer walls *28* and *29*. The central wall *27* has oppositely arranged, laterally extending portions *30* forming outwardly and downwardly inclined bottom surfaces *31* for said passages *14*. Each of the outer walls *28* and *29* has oppositely arranged, inwardly extending portions *32* and *33*; the portions *33* having surfaces *34* downwardly and inwardly inclined toward the central wall *27* The inwardly extending portions *32*



and *33* of the outer walls *28* and *29* are disposed above the respective inclined surfaces *31* and the under surfaces of said portions *32* and *33*, which are in the form of a series of stepped arches *35*, are inclined upwardly and inwardly over the surfaces *31*; the stepped arches *35* providing heat deflecting surfaces above said inclined surfaces *31*.

The granulated particles of the material to be burnt are fed from the hopper *15* into the upper ends of the upper passages *14*; and the feeding of the material is controlled by two valve devices *36*, one for each passage. Each valve device *36* includes a horizontal cylinder *37* fixed between the bottom portion of one of two downwardly converging, inclined walls *38* forming the bottom of the hopper, and the central wall *27* which extends a slight distance up into the hopper *15*. Fitted within each cylinder *37* is a longitudinally slidable cylinder *39* having at one end a projecting arm *40* connected to a long lever arm *41*, whose upper end is fulcrumed on a bracket *42* projecting from the wall of the furnace. The lower end portion of each lever *41* extends through a guiding bracket *43* and is provided with a suitable handle *44* by means of which the lever may be operated to move the inner cylinder *39* longitudinally within the outer cylinder *37* The top and bottom walls of the two cylinders *37* and *39* are provided with longitudinal rows of perforations; relatively arranged, so that longitudinal movement of the inner cylinder will bring said perforations into and out of registry, permitting the material within the hopper *15* to feed by gravity therefrom and into the passages 14, when the perforations are in registry, and stopping the feeding of the material when the perforations are out of registry It will thus be seen that the supply of material from the hopper *15* to the passages *14* may be started and stopped and regulated by operating the levers *41* to move the inner cylinders *39* within the outer cylinders *37* The structure is provided with two flues *45* which communicate at their inner ends with the upper ends of the passages *14*, and extend outwardly therefrom beneath the hopper *15* and terminate at their outer ends in expanded cleaning boxes *49* which are supported by suitable I-beams carried by the brick-work of the furnace. Rising from and communicating with each cleaning box *46* is a chimney *44* which is provided with a suitable damper *48* which may be adjusted to regulate draft within the chimney Extending downwardly from and communicating with the boxes *46* are pipes *49* which are supported by suitable brackets *50* extending outwardly from the brick work of the furnace. The upper ends of the pipes *49* are normally closed by suitable slide plates *51* which may be drawn outwardly to open communication between the boxes *46* and pipes *49* for cleaning purposes, and which may be moved inwardly to close the upper ends of the pipes *49* to prevent air from entering the boxes *46* through the pipes *49* when the furnace is in operation. The side walls of the flues *45* and cleaning boxes *46* have openings normally closed by suitable doors *52* and *53* through which access may be had to the flues and boxes for cleaning soot and dirt therefrom. When the flues and boxes are cleaned, the plates *51* may be moved to uncover the upper ends of the pipes *49* and the soot and dirt may be pushed into the pipes *49* through which they will descend and may be caught in any suitable receptacles placed beneath the lower ends of the pipes. The outer walls *28* and *29* have openings adjacent to the lower ends of the respective sets of passages *14* which are normally closed by suitable doors *54* and *55*, respectively, and through which access may be had to said passages for cleaning and other purposes. The front wall *56* of the combustion chamber *12* has a peep-hole *57* therein which is normally closed by a hinged plate *58*; and the wall *56* has another opening *59* therein through which fire may be applied to the burner *18* to ignite the fuel issuing therefrom. The opening *59* is normally closed by a hinged plate *60*. The walls *27*, *28* and *29* and their projections *30*, *32* and *33*, provide zigzag channels, as shown in Fig. 3, which include the passages *14*. By reason of the inclined surfaces *31* and *34*, material fed from the hopper *15* will gravitate through said zigzag channels; passing from the upper inclined surfaces *31* first receiving the same to the inclined surfaces *34*, thence to the lower inclined surfaces *31*, of the lower passages *14*, and dropping from the latter on to the converging walls *16* and *25* forming the bottom of the heating chamber *13*. From said heating chamber the material passes to and through the opening *26* into the combustion chamber *12* and then on down over the inclined surface of the back wall *16* of the heating and combustion chambers to and through the discharge passage 23 at the bottom of the furnace. From the passage 23, the material falls into any suitable receptacle placed beneath it.

TRANSPORTING SUGAR CANE FROM FIELD TO MILL. *Simes T. Hoyt* (assignor to the *Hawaiian Pineapple Co., Ltd.*, of Honolulu, T.H.). *1,503,365.* July 29th, 1924.

In order to obviate the delay which may occur in the present system of collecting and transporting cane from field to mill, the invention contemplates a system of transportation, which is partly permanent, partly temporary and partly portable, so that it will be capable of being adapted for progressively cutting cane in any number of different fields; and, as the cane is cut, the process of conveying it to the mill will be immediately initiated and uninterruptedly continued during the harvesting period. Transportation of the cane to the mill is performed pneumatically, the system being provided with regularly-spaced blowers or boosters, whereby, renewed impulses may be imparted to cut the cane throughout its entire course of travel. Temporary and portable sections of the conveying conduits are provided, said sections being equipped with blower mechanisms, permitting the introduction of cane to the main conduit, at any portion of the particular field being harvested. Associated with the receiving end of the conveyor is a mobile unit comprising a cutter and blower, for the purpose of cutting up the cane in proper lengths to be received by the conveyor. The blower connected with the cutter provides the necessary force for directing the cane into the conveyor, where it is subsequently picked up and continuously conveyed through the proper conduit by the regularly-spaced blowers or boosters provided throughout the system. Lastly, water supply is associated with the cutter and blower at the receiving end of the conveyor, whereby the water is mixed with the chopped cane and, during its travel through the conveyor, prevents the passage through and between the cut portions of cane of the propelling air from the several blowers. Claim 4 reads as follows: A conveying apparatus for chopped sugar cane and similar material, comprising a conveyor conduit having its discharge end at the mill, and its receiving end at the harvesting field, a portable conduit adapted for connexion to the main conduit, means adapted for connexion to the receiving end of said portable conduit, to add a fluid to the chopped cane thereto, to divide said mixture of cane and fluid into measured sections, to successively introduce said sections into the receiving end of the portable conduit, and to subject each section, after it is received in the conduit, to a blast of compressed air, and means for applying additional compressed air to the rear of said sections, during their passage through said conduits, substantially as described.

MANUFACTURE OF ADSORBENT (DECOLORIZING) CARBON. *Newcomb K. Chaney*, of Kew Gardens, New York, U.S.A. *(A) 1,497,543. (B) 1,497,544.* June 10th, 1924.

These two specifications state the inventor's theory of the formation of "primary carbon" as consisting of a highly absorbed carbon base containing adsorbed hydrocarbons, and also disclose his processes for making adsorptive carbons by differential adsorption. (A) Claim 6:—Process of making highly adsorptive carbon, comprising subjecting a carbonaceous material to low-temperature distillation to expel volatile components while avoiding deposition of inactive carbon, producing thereby a primary carbon consisting essentially of an adsorption-complex of active carbon and stabilized hydrocarbons, subjecting said primary carbon to differential oxidation until the exposed hydrocarbons are substantially eliminated, and subjecting the residual active carbon to limited oxidation until it has acquired substantially the maximum retentivity per unit of volume. (*B*) Claim 4:—Process of making a highly adsorptive carbon, comprising subjecting a vegetable material adapted to form charcoal of block density greater than 0·70 to low-temperature distillation to expel volatile components while avoiding deposition of inactive carbon, producing thereby a primary carbon consisting essentially of an adsorption-complex of active carbon and stabilized hydrocarbons, and subjecting said primary carbon to differential oxidation until the exposed hydrocarbons are substantially eliminated, and subjecting the residual active carbon to limited oxidation until it has acquired a retentivity for chlorpicrin in excess of 100 mgrms. per c.c. of grain-volume.

Evaporating Pans (presumably for Syrup Manufacture). *Arthur D. Stevens and Naulbert A. Gilbert*, of Jacksonville, Flo., U.S.A. *1,512,505*, October 21st, 1924.

Decolourizing Carbon. (*A*) *Byron E. Eldred and Robert N. Graham*, of Long Island City, N.Y., U.S.A. *1,515,942*. September 18th, 1924. (*B*) *Frank M. Dorsey* (assignor to *General Electric Co.*, of New York). *1,517,543*. (*C*) *Robert C. Allen* (assignor to *Henry L. Doherty & Co.*, of New York, U.S.A.). *1,517,523*. December 2nd, 1924. (*D*) *Y. Inada*, of Takaw, Formosa. *1,521,541*. December 30th, 1924. (*E*) *L. H. Bonnard*, of London. *1,520,801*. December 30th, 1924.

(*A*) Carbonaceous material is separated from mixtures containing the same by "entering the mixture into a body of water whose surface is subjected to a vacuum, whereby the carbonaceous material floats at the surface and above it, maintaining the floated material for a sufficient time and under sufficient vacuum to destroy its buoyancy, whereby it sinks . . . ." (*B*) Claim is made for "the steps which consist in first subjecting carbonaceous material to a distillation process at a temperature above 700°C.; and then after such distillation process has progressed at least two hours, but before its completion, subjecting such material to the action of a gas capable of preferentially oxidizing the residual hydrocarbons in such material." (*C*) Claim is made for "in a process of the character described, the step which consists in passing an activating medium transversely through a moving body of carbonaceous material." Claim is also made for an apparatus "including pre-heating, activating and cooling chambers, through which the material to be treated may be passed in succession, a combustion or distributing chamber connected with said activating chamber, a gas duct leading from the latter to said pre-heating chamber, and a steam generating chamber connected to receive gases from said pre-heating chamber and to supply steam to said combustion chamber." (*D*) Japanese coniferous wood having a fragrant volatile resin, is so treated that the volatile matter is first driven out by heat, after which the residue is impregnated with potassium acetate, and again heated. (*E*) A porous carbonaceous material is immediately incorporated with "an oxidic calcium compound," afterwards retorting at 1000°C., continuing heating at a high temperature to materially increase the activity of the product, and thereafter treating the product to remove the lime.

Cube Sugar Packing Machine. *Henry Deppel*, of San Francisco, Calif., U.S.A. *1,515,937*. November 18th, 1924.

Claim 1.—A device . . . . comprising a base member, a receptacle mounted thereon in which cube sugar may be packed in layers, and means for contracting the receptacle to move the cubes into a compact assembly.

Production of Butyl Alcohol and Acetone by Fermentation of Molasses *G. C. Robinson* (assignors to the *Atlas Powder Co.*, U.S.A.). *1,510,526*. October 7th, 1924.

Low purity molasses is first mixed with an activated decolorizing carbon which prevents interference with cell division by toxic materials in the molasses, and then with a mass of fermenting cereal material having ferment-producing organisms in a well-advanced state of cell division.

Cane Harvesting Machine. *Henry O. Scranton*, of Jeanerette, Louisiana, U.S.A. *1,491,069*. April 22nd, 1924.

Claim 6:—In a harvester, a supporting frame, two vertically slidable shafts journaled in the frame, cutters secured on the shafts and forming a pair of shears, links pivoted at their upper ends to the frame, and free to rock longitudinally of it, levers pivoted between their ends to the lower end portions of the said links, blocks pivoted to the said levers and operatively connected with the said shafts and cutters, means for moving the levers pivotally to raise and lower the said shafts and cutters, and a plate for the lower ends of the cut plants to rest on supported from the two said blocks and arranged above the said cutters.

CENTRIFUGAL MACHINE BRAKE. *Eugene Roberts*, (assignor to *The Western States Machine Co.*, of Salt Lake City, Utah, U.S A.). *1,508,577* September 16th, 1924.

Claim 2 : In a brake for a gyratory centrifugal or the like, the combination of a rotary brake element secured to and rotating with the gyratory shaft, movable brake members mounted on a fulcral support to be moved against and away from the rotary element, friction slides mounted in said brake members upon universal joints whereby the friction slides adjust themselves to the angular deflection of the rotary element but of the plane of movement of said brake members by reason of the pressure between the slides and said rotary element in order to equalize the pressure on different portions of the friction surface, substantially as described.

PRESSURE FILTER (SWEETLAND TYPE). *Ernest J. Sweetland* (assignor to the *United Filters Corporation*, of New York, U.S A.) *1,510,568*. October 7th, 1924.

Claim 1 :—In a pressure filter, a closed casing, a rotable drainage pipe mounted in said casing, a plurality of separable filter leaves mounted on said pipe, spacing members located between the leaves and spaced from the pipe, and compressed means spaced from the pipe and adapted to form a fluid-tight joint between the leaves and the spacing members, the leaves and spacing members being slidable with reference to the pipe, and means for applying compression to an assembly of leaves, spacing members and compressible means for locking them on the pipe.

BEET TOPPERS. (*A*) *Ole C. Hanson*, of Hopkins, Minn , U.S A. *1,502,384*. July 22nd, 1924. (*B*) *Elmer L. Amble*, of Frost, Minn , U S A. *1,510,452*. October 7th, 1924. (*C*) *Reinhold Bohman*, of Bay City, Mich., U.S.A *1,513,737*. November 4th, 1924.

BEET HARVESTERS. (*A*) *Samuel C. Beale*, of Los. Angeles, Cal., U.S.A. *1,503,625*. August 5th, 1924. (*B*) *Frank W. Knowles*, of Seattle, Wash., U.S.A. *1,504,484*. August 12th, 1924.

BEET CUTTERS. *Herman L. Hartburg*, of Denver, Colo., U.S.A. *1,483,803*. February 12th, 1924. BEET LIFTING BLADE. *Charles E. White*, of Moline, Ill., U.S.A. *1,489,570*. April 8th, 1924. BEET DIGGER AND TOPPER. *L. P Christensen*. *1,491,517*. April 22nd, 1924. BEET DRILL *H. Wilson*, of Ada, Okla., U.S.A *1,513,613*. October 28th, 1924. BEET DIGGER. *John W. Little*, of McCook, Nebr., U.S.A. *1,513,833*. November 10th, 1924. BEET LOADING MACHINES. *Ellie C. Evans and Patrick C. Roberts*, of Wiley, Colo., U.S.A *1,509,129*. September 23rd, 1924.

CENTRIFUGALS. *Albert J. Gravenberg*, of Savannah, Ga., U.S.A. *1,510,776*. October 7th, 1924. (*B*) *William C. Coleman*, of Wichita, Kans., U.S.A. *1,510,657*. October 7th, 1924. (*C*) *Alfred Melotte*, of Remicourt, Belgium. *1,513,337*. October 28th, 1924. (*D*) *Henry D. Hellmers*, of Las Vegas, Nev., U.S.A. *1,512,687*. October, 21st, 1924.

FILTERS. (*A*) *Charles C. Ahlum* (assignor to *E. I. du Pont de Nemours & Co.*, of Wilmington, Del., U.S A). *1,498,313*. June 17th, 1924. (*B*) *Francis W. Brackett*, of Colchester, England. *1,504,020*. August 5th, 1924. (*C*) *Oscar B. Depue*, of Chicago, Ill., U.S.A. *1,512,977*. October 28th, 1924. (*D*) *Geo. D. Dickey and Harry W. Conrad*, of New York, U.S.A. *1,514,955*. November 11th, 1924. (*E*) *Edwin Morrison* (assignor to *The Great Western Sugar Co* , of Denver, Colo., U.S.A.). *1,515,130*. November 11th, 1924.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1925. Tons.	1924. Tons.
Total Receipts, January 1st to January 28th	178,737	160,060
Deliveries ,, ,,	171,738	160,854
Meltings by Refiners ,, ,,	166,650	136,230
Exports of Refined ,, ,,	1,200	2,200
Importers' Stocks, January 28th	6,999	—
Total Stocks, January 28th	40,164	49,383
	1924.	1923.
Total Consumption for twelve months	4,854,479	4,780,684

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1921-1922, 1922-1923, AND 1923-1924.

(Tons of 2,240 lbs.)	1921-22 Tons	1922-23 Tons	1923-24 Tons
Exports	3,866,886	3,477,745	3,928,863
Stocks	8,478	—	1,409
	3,875,364	3,477,745	3,930,272
Local Consumption	121,023	125,165	124,687
Destroyed by Incendiaries	—	—	11,683
Total Production for Season	3,996,387	3,602,910	4,066,642

Havana, December 29th, 1924

J. Guma.—L Mejer.

Sugar Crops of the World.

(After Willett & Gray.)

	CANE	BEET.	TOTAL.
1913-14	9,801,536	8,634,942	18,436,478
1914-15	10,176,654	8,306,778	18,483,432
1915-16	10,615,876	6,254,018	16,869,894
1916-17	11,331,998	5,772,864	17,104,862
1917-18	12,366,569	5,015,262	17,381,831
1918-19	11,918,591	3,883,003	15,801,594
1919-20	12,235,762	3,259,380	15,495,142
1920-21	11,952,928	4,687,412	16,640,340
1921-22	12,700,974	4,914,081	17,615,055
1922-23	12,916,878	5,202,661	18,119,539
1923-24	13,838,069	5,861,478	19,699,547
1924-25 (Estimate)	14,651,867	8,133,400	22,785,267

United Kingdom Monthly Sugar Report.

Our last report was dated the 12th January, 1925.

The market throughout the period under review has maintained a steady tendency and at times a firm tone has prevailed. Prices generally are on a higher level than a month ago.

Business on the terminal market at first was not large, but later a greater interest has been shown and dealings have been heavier. Speculation is taking more interest and there are distinct signs that sentiment is slightly changing. Tenders in liquidation of January were quite small and dealings in this month took place from 17s. 3d. to 18s., finally being liquidated at 17s 10½d. March sold from 17s. 3d. to 17s. 9d. to 17s. 4½d. to 18s. 3d. to 17s. 9d. to 18s., May sold from 17s. 4½d. to 17s. 10½d. to 17s. 4½d. to 18s. 3d. to 18s., August sold from 17s. 6d. to 1s. 10½d. to 17s. 6d. to 18s. 3d. to 18s. A fair business was done in new crop, October/December sold from 17s. 7½d. to 18s. 1½d to 18s., and December alone from 17s. 6d. to 18s. 1½d. to 1s. 10½d. The latest prices are February 1s. 9d., March 18s., May 18s., August 18s. 1½d. and October/December 18s.

Trading in actual sugars has been fairly brisk, Dealers, owing to their hand to mouth policy, have let their stocks run down to a minimum, and with the navigation on the Elbe interfered with by ice a very steady demand has existed day by day for ready and near at hand sugars. Fine Granulated on the spot has advanced from 31s. to 31s. 6d. and the latest quotation is 31s. 3d. The scarcity in lower grade Granulated is very marked and good Polish sold at 30s. 10½d. and Javas at 30s 6d. The Anglo-Scottish is practically the only English factory which had any sugar to sell, and their price has been stationary at 32s. 3d. A good business was done in White Javas for May/June shipment at 17s. 6d., June/July 17s. 4½d. to 17s. 3d., and July/August at 17s. 3d. to 17s. 1½d., all c.i.f , U.K. Canadian Granulated was sold from 18s. 6d. to 18s. 9d. c.i.f. for February/March shipment. Czecho Granulated ready sold from 17s. 9d. to 18s. 4½d., and a good business was also done in ready Dutch Fine from 17s. 9d. to 18s. 3d There is a little more demand for forward and the prices ruling have been the same to 1½d higher than prices for ready or prompt. German sugars have not been offered at anything like parity. Belgium Granulated and Crystals have advanced from 17s. 6d. to 18s

The British Refiners have been constant buyers of raws, and as Cubans were the only sugars available for them a large steady business has been transacted from 13s. 6d. to 14s. c i.f. U.K.

The British Refiners reduced their prices on January 14th by 6d. per cwt. for spot and 3d. per cwt. for forward. Their March quotation of 31s. 9d. comparing very favourably with any other foreign imported sugar, they did a very large business at this price. On February 2nd they advanced the price of second half February by 3d. per cwt., bringing it into line with the spot price, and March by 3d. per cwt. to 32s. Their latest quotations are No. 1 Cubes 36s. 6d., London Granulated 32s. 4½d.

There has been a steady demand for Refined in America and the Refiners have been constant buyers of raws. The chief business has been done in Cubans from 2¾ to 2⅞ cents c.i f., Porto Ricos and Philippines at 4·52 to 4·59 c.i.f.

The Cuban crop is maintaining its satisfactory progress and the receipts to date are 130,000 tons more than this time last year. There are complaints that the yield is not so good as in 1924, and there are rumours that the crop will not reach 4,500,000 tons, but the official statisticians have not yet reduced their original estimates.

It is interesting to note that it is estimated that the U.K. will produce during the campaign 1925/1926 75/80,000 tons from the beet sugar factories now working and those in course of erection.

21, Mincing Lane,
London, E.C 3.
February 9th, 1925.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE

INTERNATIONAL SUGAR JOURNAL.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 315. MARCH, 1925. Vol. XXVII.

Notes and Comments.

The British Sugar Subsidy Bill in Parliament.

The second reading of the British Sugar Subsidy Bill took place in the House of Commons on February 18th, being moved by the Minister of Agriculture (Mr. Edward Wood). His speech was largely concerned with emphasizing certain arguments already advanced in previous debates and in commenting on some of the objections raised by the opponents of the measure. At the outset he quoted some figures from a Lincolnshire farmer to demonstrate the good effect of sugar beet growing on English agriculture. Not only were the beet tops and the molasses an excellent cattle food, but the corn in that district as the result of rotating beets yielded from one to two sacks per acre more than after other root crops. Then he emphasized how vital it was for the success of this industry for both farmers and factories to co-operate in the production of beet of the highest possible sugar content; he was very glad to know that the Farmers' Union, the seed merchants, the factories, and the Royal Agricultural Society were all putting their heads together to study the question of the production of the best beet and of the best and most suitable seed in this country.

Mr. Wood went on to deplore the hostile attitude adopted by the big co-operative movements in this country against the scheme; although these bodies were prepared to push their ramifications till they got back to the farm in all parts of the world, yet as soon as a concrete proposal enabled them to do the same in England, they found a hundred good reasons for not doing it, whereas they might very well go into the business themselves, establish their own factories, and thereby extend the industry. As for the argument that the Government were establishing a vested interest, there was more danger on that score from the foreign competition which sent us most of our sugar and would continue to do so.

Then Mr. Wood turned to the question of the refiners' objections which he thought even on their own assumptions were greatly overstated. The refiners' case was very fully considered by the late Government and was in all respects most carefully reviewed. As a matter of fact these proposals have been under the review of four different Governments. He himself had met the refiners and endeavoured to the best of his ability to ascertain the point of their grievances. But, for one thing, the refiners used very loose language when they talked about the advantage of the subsidy of 21s. 5d. What advantage were the white sugar people going to have out of this figure? The 21s. 5d. had to do a good deal. It had to secure the growing of beet by the farmers, and to make up the difference of wages that are paid in this country as compared with Continental countries; and this share of the subsidy could not be claimed to affect the refiners Moreover, as he reiterated, the incidence of subsidy was based on the Customs scale which, if it was fair for Customs duty, was fair also for subsidy allowances.

Then Mr. Wood dealt with the allegation that the business of these new factories would cut exclusively into the business of the old refineries. "The future of the refiners depends [he remarked] much more on their ability to compete with foreign refined sugar than upon anything else It is very likely that the refiners to-day are being hit, but that they are being hit by a bigger thing than the subsidy to home-grown sugar. They are being hit by a general drift of world sugar production I am going to suggest as one who has addressed himself to the subject, and endeavoured to bring an impartial mind to bear upon it, that they are using this proposal as a peg upon which to hang a plea for general protection against foreign competition They may say that they see no reason that the new production will cut exclusively into the foreign field, and not into theirs. On the other hand, I say to them that I see no reason to suppose that the new production will cut exclusively into them and not into the foreign. In fact, the truth of the matter is that at this moment the consumption of sugar due to the remission by Mr. Snowden of the sugar duty is increasing, and that is another ground why the refiners need feel less alarm than they unhappily seem to do. Apart from that, I myself have no doubt that if the subsidy were so drawn as to discourage factories from undertaking what is called the 'continuous process' in this business, it would be to establish them on a basis, unprofitable and uneconomic. That is, I think, supported by ample evidence from a great many different countries. I have heard doubts expressed by the refiners as to whether this industry, once established, will be able to make good at the end of the ten years' period. Very likely these doubts would be reinforced if this industry were compelled to develop upon lines which the best modern practice is throwing out of date Therefore, I think a case for the encouragement of the continuous process in this production is overwhelming."

And to emphasize this last remark Mr. Wood was good enough to add: "*Let me quote from what I believe to be an impartial journal, the 'International Sugar Journal,'* which on this subject in January last said something which may have more weight than anything I can say," and he then proceeded to read to the House a portion from our January *Notes and Comments*, in which we laid it down that any desire of the refiners to retain their monopoly at the expense of home beet sugar manufacturers was not one that could be countenanced, and that the new factories must have freedom to turn out just that type of sugar that it pays them best to manufacture.

As a final remark Mr. Wood said that "the refiners' opposition to the establishment of the beet sugar industry is not peculiar to ourselves. Exactly the same thing happened in the United States. The refiners of raw cane sugar from Cuba were up in arms against the establishment of the beet industry on similar lines to what we are doing here. Their objections were overruled, and both industries since then have continued to progress side by side. I see no reason why that same happy result should not follow here."

Notes and Comments.

The Refiners and Foreign Competition.

Mr. WOOD (in his speech above chronicled) rightly, we think, suggested that what the refiners were really up against was foreign competition. Overseas sources are no longer content to send us raw sugars for our refineries to melt; the American refiners have since the war embarked on a policy of sending their surplus stocks of refined to the European market, some of which enters England. And Czecho-Slovakia, Holland and Belgium have been doing likewise. The imports of refined sugar into this country during 1924, according to the Board of Trade Returns, totalled 600,000 tons or about one-third of our total imports that year. The refiners claim that their establishments in this country can deal with 1½ million tons of raws or practically the amount of the present consumption. But we think we are right in saying that this capacity has only been in existence a few years, the refineries having been enlarged during the war years; and we question whether there has been a single year when the refineries have worked to anything like the whole of this enlarged output. If we have premised correctly, then the position is simply that the refiners, as a result of the abnormal conditions existing during the war, have counted on attaining an output which subsequent years of more normal competition have not allowed to develop; instead, the foreign refining interests have invaded our market in increasing force, our enlarged refineries have failed to secure full employment, so the new form of competition which the home beet sugar industry is introducing is being made the "whipping boy" for the evils arising in the main from quite different directions.

Mr. WOOD seemed to think that the refiners' real aim was a plea for general protection against foreign competition. We think it would have been better if from the outset they had emphasized the seriousness of this competition, instead of attempting to throttle the nascent beet sugar industry at home. Their attitude rather reminds us of the familiar case of the medium-sized dog who having had the worst of an encounter in the street with a big rival, meets a smaller canine on the way home, and vents his spleen on the inoffensive creature. If the country had given the Government a mandate for protection, we should have been amongst the first to suggest that the home refining interests should have a preference against foreign refined—it is only what every other sugar producing country would do in the interests of its own workers—but as the polls have decided otherwise, it is inevitable that our refiners, like other manufacturers in this country, must put up with the foreign competition that the free trade proclivities of the electorate have chosen shall continue. We suggest, however, that if the refiners urgently need protection from such competition, they should try their luck with the new Safeguarding of Industries measure which the Government are about to introduce and which is destined if it passes into law to assist special cases of hardship in trade. What is patent is that the House of Commons are clearly of a mind to refuse to stultify the prospects of British sugar beet agriculture and beet sugar manufacture by differentiating the scale of the subsidy in the interests of the refiners. The right remedy in this direction is for the refiners to embark on home sugar production on their own account; and they are realizing this sufficiently to make a start at once. Not only have Messrs. Tate & Lyle, Ltd. taken a share in the United Sugar Company's new factory at Bury St. Edmunds, but one of the Liverpool refineries is being converted to deal with beets, which we understand will be grown by farmers in the fertile west Lancashire agricultural districts. And a Greenock refinery is reported to be doing similarly in its own district.

The Real Value of an Indigenous Beet Sugar Industry.

Before leaving the subject this month, we must refer to the fears expressed in some quarters as to what will happen to the home beet sugar industry at the end of the ten years when the subsidy is withdrawn. It is implied that, with the latter gone, the industry will be unable to compete with tropical cane sugar. Whether when that time comes England will be able like Holland to run her sugar industry on free trade lines, or like America must continue some degree of preference, can only be decided when the end of the subsidized decade arrives. On another page we reproduce some interesting data from the pen of Mr. TRUMAN G. PALMER, the eminent U.S. sugar expert and statistician, showing clearly that the difference in cost of production between Cuban cane sugar and American domestic beet is so marked that a continuation of the import duty is imperative if the latter industry is not to be crushed out. But it is not a case of bolstering up a bad industry; two important results are ensured that would equally apply to beet agriculture in this country. The cereal farmers get the marvellous rotating value of sugar beet; and the sugar market enjoys the moderating influence of a source of sugar independent of the tropical cane sugar producers and of the refiners. As regards the first, Mr. PALMER points out that German agriculturists, thanks to the existence of beetroot in their rotation, get just double the amount of wheat, of oats, and of potatoes to the acre that the American farmers outside the beet tract obtain. As regards the second reason, it is obvious that a sugar production well distributed will tend to prevent monopolies on the part of those who endeavour to corner such huge crops as Cuba and Java turn out; price fluctuations whether caused by market manipulation or by the failure of one predominating crop will be less violent; so the consumer in this country and elsewhere stands to gain. And so, it may be added, does the cane sugar producer in the British Empire, since he is particularly susceptible to the influences of big foreign crops like that of Cuba, and there is nothing to suggest that a British "Cuba" will ever be developed to match the extent and influence on the sugar market which that West Indian republic at present possesses.

For these reasons, we hold that whether the home beet sugar industry can establish itself against all comers or not in the ten years of preference now conceded it, it must eventually be judged not so much on that count as on its influence on other British agriculture and on its effect in keeping down the price of sugar to the home consumer by competing actively with foreign sources of supply. If a little stimulant is still needed it should be forthcoming; and, after all, Imperial preference on sugar seems to have come to stay, and the home industry can certainly count on getting that much advantage over foreign sugar (beet or cane), even if it has to compete on equal terms with cane sugar from the Empire.

The Imperial College of Tropical Agriculture.

On January 29th last, the Lord Mayor of London gave a Luncheon at the Mansion House in aid of the appeal for £100,000 to equip and endow the Imperial College of Tropical Agriculture in Trinidad. A distinguished company was present, and the subsequent speeches were listened to with great cordiality.

Mr. AMERY, the Secretary of State for the Colonies in proposing the toast of the College, emphasized the importance of the development of the Empire on the foundations laid by the late JOSEPH CHAMBERLAIN. As for the evolution of the College, they owed a great deal to the sympathy and help of Lord MILNER, when he was at the Colonial Office. But to the governing body which had brought the college into existence, they owed a great debt of gratitude; its success was largely due, he believed, to the fact that science and business met together on it on common ground and with a common object. Although it was invidious to select names, he might be allowed to mention Mr. **MOODY STUART**, the chairman of the Finance Committee, Sir **DAVID PRAIN**, and Professor **FARMER** on the scientific side, and, more generally, the indefatigable and zealous Secretary, Mr. **ASPINALL**, and the chairman, Sir **ARTHUR SHIPLEY**. On the spot the scheme had been a success, largely owing to the zeal and enthusiasm of the director, Sir **FRANCIS WATTS**, to whom there had lately come a very distinguished successor in Dr. **MARTIN LEAKE**. In the three years of its existence, the college had already justified itself, and its importance was being recognized all over the Empire. It would very shortly be endowed with a model sugar factory which was going to help to remove the humiliation and reproach that up till now sugar chemistry and technology could not be learnt within the British Empire He believed that the College was indeed destined to be a true centre of thought and an inspiration for the whole Empire.

Sir **ARTHUR SHIPLEY** remarked that every man, woman, and child in this country was dependent on the tropics to an extent which was hardly realized. Hence it was of vital importance to the entire community in Great Britain that the growth of tropical produce should be not only maintained but developed under our flag. To secure that object was the purpose of the new college. But much remained to be done before they could carry out their full programme—the completion and equipment of the new buildings and laboratories, the provision of hostels, and also of a farm or estate, for all of which purposes the sum of £100,000 now asked was needed. Incidentally, he announced that the trustees of the International Health Board had offered £1000 a year for five years to establish a professorship of Tropical Sanitation and Hygiene; this would enable young men of high training, scattered throughout the hotter regions of the world, to act as forerunners in showing the people how to escape dread tropical diseases, e.g., malaria. Till the beginning of this century the tropics and sub-tropics were almost closed, primarily owing to the existence of this malaria. That could now be overcome and open up enormous almost undeveloped tracts of land from which we could draw the food, the metals, the cotton, and the timber, which would suffice to keep this Empire well fed and even wealthy for many generations.

Viscount **BURNHAM**, who spoke for Lord **MILNER** the organizer of the appeal, said that this request for £100,000 was made on the broadest lines of Imperial patriotism. He referred to big gifts already made, including that of Trinidad of £50,000, and that of the British sugar machinery engineers who had given machinery and plant to the value of £20,000; and he stated that, thanks to the various gifts and grants, the college already had an income of from £15,000 to £18,000 a year. But every penny of the £100,000 now asked for was required, for it was based on a careful calculation of the cost of absolute essentials, which would in the end give them a tenfold return of capital and interest.

Progress of the Cuban Crop.

Our Havana correspondent writes that the Cuban sugar crop is now making rapid strides, and the output at the date he wrote (February 21st) was much ahead of that of any previous year at the same date. By the middle of February a little over 1,170,000 tons of sugar had been delivered to the seaports for exportation, which compares with the amount of 1,000,000 tons in 1924 and 1,010,000 tons in 1923 at same date. It will be seen then that a record crop is to all appearances in the making, and if the weather and the labour conditions continue favourable Cuba will this year produce well over four million tons of raw sugar. Earlier estimates placed the probable production at from 4,500,000 to 4,700,000 tons; but our correspondent has all along deemed them too high and still considers them so. They were based on yields of sucrose such as were obtained during the 1923-24 crop; but factory yields obtained this season from representative mills point to an average this year, lower than the yields to same date last year by about 0·21 per cent. This fact will make a big difference on the final output if the percentage is not increased.

Although the sucrose in the cane was increasing rapidly when our correspondent wrote, there had not been the cold weather which is so necessary to mature a rich sucrose-bearing cane The weather in fact had been very mild and very few days of cold weather had been experienced, so that, so far, in many instances yields have been on the low side and mills have not done more than cover operating expenses. Apart from that, the low price of sugar maintains a quiet market. So looking at the crop prospects from these several points of view, our correspondent sees no good reason for altering his previous estimate of a crop of 4,300,000 tons, or 6·12 per cent over last year's figures.

Indian Sugar Nomenclature.

A correspondent who has been confused by the apparently contradictory use of the terms *gur* and *jaggery* in Mr. Wynne Sayers's article on the sugar trade in India appearing in our last issue,[1] writes to suggest that these terms should be defined more accurately and be confined to what he supposes is their legitimate meaning, instead of being used indiscriminately.

It may be observed at the outset that the article in question was not primarily intended for other than Indian perusal, but as it was bound to be read by a wider circle of readers than that contained in India, there is some excuse for the complaint that the nomenclature employed in the article is largely confusing to the outsider.

As a matter of fact *gur* and *jaggery* are strictly equivalent and mean exactly the same thing, that is boiled-down juice, usually with a little lime or other substance to enable it to keep better during the rains. *Gur* is the vernacular that has outclassed all the others in north India, while *jaggery* has done the same in south India and Ceylon. Hence the apparently confusing remark cited by our correspondent that "the production of jaggery kept down the prices of gur" would mean in India in all probability that the great yield in South India forced down the prices in the north.

But it must be observed that these terms do not refer solely to sugar cane but are applied also to the products of various palms. Thus in Bombay one reads of date gur; in Madras of date, coconut and palmyra jaggery; and in Ceylon of jaggery from caryota; all of which terms are correct.

Whether gur or jaggery can be properly classified as raw sugar is perhaps a matter of opinion. Certainly they have little analogous with muscovado, for they are not the material from which sugar is made, or at any rate they should not be so used. On the other hand, they are a form of food for which more can be conceded, perhaps, than is customarily done. Gur may be often dirty, but it has much more flavour in it than sugar has a right to have, and it is exactly what the

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[1] *I.S.J.*, 1925, 100.

Indian wants as a food. In its purer forms it is in itself quite a pleasant sweetmeat and appeals to even European palates.

As a matter of fact, there are in India a vast number of different preparations of the sugar cane juice, varying from the dirtiest messes to the most beautiful crystals. *Rab* is an attempt, crude at that, at making a sort of low-grade raw sugar; here boiling is not carried so far as in jaggery, and an effort is made to drain off the non-crystallizable elements; hence it is more on a par with muscovado. When *rab* is completely washed it becomes *khand*, and a number of different forms are produced from the latter by further purification, such as *misri*, *kuza khand*, *chini*, etc. The best quality of all is *kuza khand* which is equivalent to our "sugar candy."

A final point to be borne in mind is that the gurs or jaggeries of different tracts in India differ very widely in character. That of the country around Gorakhpur is a typically bad gur, while that around Meerut is among the best in India; Bombay, if we mistake not, has generally good gur. Finally, when jaggery is required to keep during rainy periods it is sometimes heavily limed, becoming very hard and dark, when it is not pleasant to eat. It was such jaggery that used to be sent to England from the Godaveri district for the use of the breweries at home.

The Czechoslovakian Sugar Production.

According to a Department of Overseas Trade report from Prague, figures issued by the Czechoslovak Sugar Manufacturers' Association for the current season (October to January) show a large increase on those for the previous season. The January output was 56,583 tons of raw material, compared with 17,378 tons in the corresponding month of 1924. This brings the total output for the months of October to January to 1,392,300 tons, against 974,728 for the same months last season. In January the exports totalled 99,227 tons, compared with 33,087 in 1924.

	1924-25	1923-24
	(in tons of unrefined sugar)	
Stock in hand on October 1st . ..	6,816	9,235
Production (October-January) ...	1,376,953	974,728
	1,383,769	983,963

Total exports to the end of January amounted to 544,272 tons as against 342,598 in the same period of last season. These exports went largely to Italy and Trieste (174,000 tons), Hamburg (140,000 tons). England (92,000 tons, compared with 79,000 last season), Austria (46,000 tons), and Switzerland (40,000 tons). Among the other countries importing Czechoslovak sugar, Russia appears on the list for the first time since the war. The value of these sugar exports is estimated at between 1250 and 1500 million crowns.

Home consumption accounted for 145,512 tons, compared with 140,114 tons in the first four months of the 1923-24 season. Supplies on hand at the end of January totalled 693,985 tons, as against 501,251 tons in January, 1923. Finally, during the four months in question the production of molasses was 218,374 tons, compared with 147,848 tons last year.

Exports of American sugar machinery to Brazil for the nine months ending last September were, according to *Commerce Reports*, greatly in excess of the quantity during the corresponding period of 1923, being $157,869 in 1923 and $670,494 in 1924.

Fifty Years Ago.

From the "Sugar Cane," March, 1875.

This number of our predecessor happened to be concerned almost entirely with political matters concerning free trade in sugar, and with statistics regarding production in different countries. However, it contained a Report made by RICHARD HENRY BURTON on his visit to the usines of Martinique in 1872. Extracts from this seem worth while reproducing, since it describes very well the condition of the art of making sugar Fifty Years Ago.

"Unsightly, but commodious, La Renty (the largest central in the island), in good yielding weather makes 80 hogsheads of sugar a day. It has two mills; they ground in 1871, 46,861 tons of cane; 46 persons are employed to throw canes from the wagons to the cane carrier. . . . . Behind each mill are two persons to throw back any piece of megass that may not have been thoroughly squeezed. The extraction is about 68 per cent. on the weight of cane ground. The megass as it leaves the mill is carried up to a second storey by a carrier attached to it, from whence it is pushed over and thrown down to the furnace mouth of each boiler. . . . . The green megass from the platform above is at once supplied by a shoot, delivering it on a kind of platform in front of each boiler furnace, the stoker adding occasionally a little coal. . . . . . Each basket of coal is supposed to weigh 22 kg., and each boiler consumes about 36 baskets in 10 hours = 792 kg. or 1646 lbs. . . . . . At La Renty there are 11 boilers kept at work by 22 firemen (forming two separate gangs of 11 each). . . . . . The cane juice on leaving the mill passes through an iron trough or canal, having three strainers, and entering a *monte-jus* to be carried to the steam clarifiers in the upper storey of the building. There are nine of these hemispherical, double-bottomed, containing 450 gallons each. From these the clarified juice descends to the subsiders. Of these there are six. The skimmings and residue in the clarifiers is filtered and the clear juice passed on to the subsiders. At La Renty they put a small quantity of skimmings in one of these (Taylor) bags. From the subsiders the juice is passed through animal charcoal filters. There are 18 of these at this usine. The charcoal is used first to filter the syrup; on the second day they pass through it the clarified juice, and finally when it is considered unfit for this until it may be reburnt, water is passed through the filters, and this sweetened water used for making rum. After the first filtration the juice is concentrated to syrup in the "Triple Effet." There are two sets. They consist each of three vertical vacuum pans, 6 ft., 7 ft., and 8 ft. diam. respectively. They can work off 26,000 gallons of juice to syrup of 25°B. in 10 hours. The process is tedious and requires great attention on the part of the person in charge. It is expensive, cumbersome, difficult to manage, tedious, and the advantages in boiling *in vacuo* are destroyed, and glucose formed in the sugar owing to the time taken in performing the operation. Reduced to syrup of 25°B. in the Triple Effet, it is again passed through animal charcoal, and then concentrated to grain in the vacuum pans. There are 54 coolers for the first sugars, and 108 for seconds and thirds; the sugar after cooling sufficiently is passed through a *malaxeur*, or dividing machine, to break the lumps, and equalize it. From thence it is taken to the centrifugals. There are 20 of these driven by over-head gearing, all in a straight line, by forming two groups, each 10 driven by a separate engine."

The "International Sugar Journal" in Parliament.

On February 18th last during the debate in Parliament on the British Sugar Subsidy Bill, the Minister of Agriculture (Mr. EDWARD WOOD) in referring to the subject of the refiners' grievances and the difficulty of meeting them without inflicting injury on the new beet sugar industry, made the following remarks :—

"Let me quote from what I believe to be an impartial journal, the *International Sugar Journal*, which on this subject, in January last, said something which may have more weight than anything I can say. That Journal says this :

'It is obvious that any such desire of the refiners to retain their monopoly at the expense of the home beet sugar manufacturers is not one that can be countenanced in the process of building up in this country a thoroughly modern beet sugar industry. The interests of the two are—for the present at all events—largely irreconcilable, and public opinion when properly informed is all in favour of giving the white sugar factories a free hand. We are not prepared to commit ourselves at this stage to affirming that there is no means of compromise that will surmount the refiners' difficulty. But we affirm that the new factories must have freedom to turn out just that type of sugar that it pays them best to manufacture, and if they get a subsidy at all, it must not be scaled to penalize them in the matter of their given choice ' "

The British Beet Sugar Industry.

Some Questions in Parliament.

On February 10th Mr EDWARD WOOD (Minister of Agriculture) in reply to a question gave the following particulars relating to the trading operations of Kelham and Cantley :—

HOME GROWN SUGAR, LIMITED, the owners of the Kelham factory, was registered in 1920 with a share capital of £500,000, of which £250,000 was invested by the Government and £250,000 by public subscription The factory operated for the first time in 1921. In 1922 the factory was closed through the urgent necessity of reconstructing the company, to which the Government had made a further advance of £125,000 on mortgage, and to make alterations and extensions to the machinery. The factory came into operation again in 1923 and 1924.

The results of the first manufacturing season (1921) disclosed a net deficiency of £109,509, after charging £8,908 for mortgage interest and £15,564 for depreciation In 1922 the reconstruction involved the writing down of the share capital by 15s. per £1 share in order to extinguish past losses and to write down the factory to its then value, as it was built in a period of inflated prices. In 1923 a net profit of £8,831 was made, after charging £19,852 for mortgage interest and £20,872 for depreciation on the revised values. The amount spent on capital expenditure upon the Kelham factory is approximately £555,000.

The Cantley factory was built by the ANGLO-NETHERLAND BEET SUGAR CORPORATION, LTD., in 1911, and during its first four years' existence incurred a net loss of £244,364, exclusive of depreciation. The company was reconstructed as the ENGLISH BEET SUGAR CORPORATION, LIMITED, but the factory did not resume operations until 1920, since when it has been in operation each season. During the season 1920-21, there was a net loss of £145,892 exclusive of depreciation. In the years 1922-23, the period of the remission of the Excise Duty, there was a net profit of £237,374 after charging depreciation. No dividend on shares has ever been paid by the companies owning the Cantley factory. The capital expenditure to 1923 upon the construction and equipment of the factory and on development expenditure represents at least £675,000. The net loss during the whole period was £162,882, after charging interest on debentures and depreciation for two years only. No account is taken in these figures of losses through writing down the assets on reconstruction in 1916 by £212,304, or of the sum of £98,982 received by the first company on foreign guarantees.

Mr. E. F. L. Wood (Minister of Agriculture) informed Mr. Hannon, on February 16th, that there were three sugar beet factories in the country and that seven were under consideration. The capital guaranteed them, so far, under the Trade Facilities Act was £90,000. Further guarantees were under consideration. The amount of foreign capital in the factories was £473,000.

In reply to a question in Parliament on February 16th, the Minister of Agriculture stated that the number of factories proposed to be erected for the manufacture of sugar beet this year of which he had definite information was five. The names of the factories and the Directors of the Companies concerned were given as follows:—

Spalding:—Anglo-Scottish Beet Sugar Corporation —Lord Weir, Lord Invernairn, Sir John Baird, Sir Ernest Jardine, and Mr. J. B. Talbot-Crosbie

Kidderminster:—West Midland Beet Sugar Company.—Lord Weir, Lord Invernairn, Sir John Baird, Sir Ernest Jardine, Mr. J. B Talbot-Crosbie, Mr. Cecil Brinton, and Mr. Councillor Woodward

Ely:—Ely Beet Sugar Factory.—Sir James Martin, Sir Frederick Hiam, Colonel Courthope, Mr. J. P. van Rossum, Dr A. Wijnberg, and Dr. J A. van Loon.

Ipswich:—Ipswich Beet Sugar Factory.—Colonel Courthope, Sir James Martin, Sir Edward Packard, Mr. J. P. van Rossum, Dr. A. Wijnberg, and Dr. J. A. van Loon.

Bury St. Edmunds:—The United Sugar Company —Sir Ernest Tate, Sir Leonard Lyle, Mr. Charles Lyle, the Earl of Denbigh, Sir Douglas Newton, Dr. Albert Hirsch, Dr. Edward Aczel, and Baron Paul Korfeld.

In Parliament on February 24th, Mr. Guinness, in reply to Mr. Hannon, said that the names of the Companies to which the beet sugar subsidy would apply were:—

1924-25 season: Anglo-Scottish Beet Sugar Corporation, English Beet Sugar Corporation,

1925-26 season: Anglo-Scottish Beet Sugar Corporation, English Beet Sugar Corporation, West Midland Beet Sugar Co., Ely Beet Sugar Factory Co., Ipswich Beet Sugar Factory Co , and the United Sugar Co.

The subsidy would also apply to any other companies manufacturing sugar or molasses from home-grown beet in the 1925-26 or subsequent seasons in conformity with the conditions under which the subsidy was granted.

The Treasury had, on the recommendation of the Trade Facilities Act Advisory Committee, guaranteed the principal and interest of loans of £370,000 to be raised by the Anglo-Scottish Beet Sugar Corporation, Ltd., and £150,000 to be raised by the West Midland Sugar Co., Ltd., for the purchase of machinery and plant.

Poland.

Official Sugar Statistics of the 1924-25 Campaign.

(Basis White Crystals.)

	October/January, 1924 25. Metric tons.	Octob./Jan., 1923/24. Metric tons.
Stocks, October 1st	12,734	5,287
Production	433,380	323,393
Home Consumption	74,464	67,480
Exports	136,760	59,570
Stocks, February	1925: 234,900	1924: 201,680

Sugar Cane Work in Porto Rico.[1]

The main factors in the success or otherwise of a research station are the character of the staff and the conditions under which they are working. It is of course vital that such staff should be more or less permanent, for this alone will enable them to detect the more important and difficult problems involved, and deal with them through such a period of time as to enable them to reach a definite stage in progress if not of finality. But, as everyone knows, Porto Rico has had a peculiar experience in this matter; and each year important changes in personnel have been reported, while vacancies in certain sections have sometimes been long continued. As a result of this, much promising work has been commenced only to be left half done; it is unreasonable to expect any two researchers, even on the same question, to work along exactly the same lines, and much dislocation has been introduced when the vacant period in an appointment has been eliminated. Losses in staff have been especially serious during the last few years, and the repeated remonstrances of successive Directors of the Station, falling on deaf ears, have afforded little hope of improvement in this matter. The public of Porto Rico has been kept fully informed of this hindrance to effective work by the publication each year of a table containing full details of the personnel, resignations, periods of occupancy, reappointments, and so on; and in the table of 1923-1924, it is with peculiar pleasure that we note that the tide has apparently turned at last. From a comparison of the lists given during 1922-1923 and 1923-1924, it would appear that during the former year there were seven resignations in 14 scientific appointments (in the posts of Chief Pathologist and Horticulturist two changes occurred); whereas, in the year under review, no resignations are recorded in 17 appointments (three assistants being added).

There are thus indications that this canker of the department is in process of healing up, and one is naturally interested in trying to find out the cause of the change. The reason is not stated, but from a study of the financial statement it is observed that the appropriation for salaries has been increased from $41,000 to close on $55,000, while the travelling allowance has risen from $2500 to $3500 during the period. The whole appropriation for the Station for the biennial period July 1923 to July 1925, has risen from $62,000 to $85,000, and a considerable portion of this has been allocated to improving the position of the staff. It is true that in several instances the resigning members have obtained better paid positions in the island itself, and the retention of such men as F. S. **Earle** and E. D. **Colón** in Porto Rico will be of great ultimate importance; but this does not affect the question of the actual working of the Insular Experiment Station.

In these favourable circumstances, it is natural that the report of the Director, R. **Menéndez Ramos**, commences on and maintains an optimistic tone, much more so than we have noticed of late years. He writes "We are fully convinced that no other similar outlay of public funds could be put to better use. When we consider that the total area of Porto Rico is little over 3600 square miles and that the island supports at present a population of probably 1,400,000 inhabitants, the need of intensive, productive agriculture is self-evident." As to the relative importance of the sugar industry, he writes "Most of the work of the Station continues to be with the sugar cane . . . . The sugar cane is generally considered a sound source of wealth . . . . A prosperous sugar industry with reasonable profits in the fields and factory will always be a big asset towards the general welfare and progress of the community. During the last 25 years sugar cane has been easily our most important crop." And, moreover, we seem to detect a new feeling in the reports of the various chiefs of sections of scientific work, repeated lamentations as to the closing-down of important lines of study being no longer in evidence; so that the 100 odd pages of the report have been read with more interest than usual.

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[1] Annual Report of the Insular Experiment Station, Porto Rico, 1923-1924.

Sugar cane varieties.—The Director reports that this line of work, which was referred to in our review of the Report of 1922-1923,[1] was carried on with considerable energy, the collections being placed under the care of A. H. ROSENFELD, who has become Cane Technologist; the Station is to be congratulated on securing the services of so hard-working and experienced an officer. BH 10 (12) again headed the list of introduced varieties, and has now been planted out on a crop scale over several thousand acres. In Porto Rico conditions, it is described as tillering well and yielding heavily and, besides being a good ratooner, as maturing early and giving a juice of high sucrose content. Santa Cruz 12/4, which had several bad marks against it in the previous report, appears to have somewhat recovered its position as a close second to BH 10 (12), and is even preferred to it in certain districts where it "grew wonderfully well" But the early maturing L 511 has not come up to expectations in that, although developing fast during the first five or six months, it was later surpassed by several other varieties under experimental cultivation. This is also the case with Badila, which does not now appear to be suited to Porto Rico conditions. Three Demerara seedlings are still being investigated. D 216 shows great vigour, germinates, tillers and ratoons well; and, by its erect habit, thick cane and dense mass of dark green foliage, appears likely to be a favourite. D 1135 shares the first three characters with D 216 and is considered to be a valuable variety; and D 117 is especially useful for long planting. Further Demerara seedlings are mentioned. D 74 has not yet made good, but a fresh supply direct from Demerara has been obtained for further experiment. D 433, the standard cane for Fajardo district (the eastern coast), did not do well in the varietal plots. Besides BH 10 (12), three other Barbados seedlings have been introduced and are being tested, but they do not appear to be equal to the variety named; these are Ba 11569, 6032, and 67. H 109 has done well and is being rapidly propagated; it does not show extraordinary growing power and will, it is stated, have difficulty in surpassing several of the varieties already growing in the island.

Uba continues to be the best cane for the western coast, although others of a similar type are being tried. On the south coast it was at first only planted on the poorer lands; but recently it has been extended to the dry alluvial flats and, with proper curtailment of the irrigation for the three or four months before grinding, it has been found to surpass Cristalina and other standard varieties. An exceptional yield of 8·64 tons of sugar per acre is reported from a field 6½ acres in extent. There is thus still much to be learnt concerning this variety. Of the seedlings raised in Porto Rico and already extensively tested, nine are given as the most promising, while among the more recent seedlings (that is since 1915) only a few are being grown on. Cane seedlings have, it is stated, become very popular in the island.

Further details of the work in cane varieties are given in ROSENFELD's Report which is appended. Much time was at first devoted to making himself acquainted with the conditions in the sugar cane tracts of the island; and, later, in rearranging and bringing up to date the exhaustive card index of varieties prepared by his predecessors. All the varieties growing on the Station were studied in connexion with their past records, and a number of eliminations were effected so as to bring the list within a reasonable compass for intensive study. For this purpose the card index was separated into two separate sections, consisting of "active" and "discarded" varieties. A list is given of the former set, i.e., of varieties actually under trial at the Insular Experiment Station on 30th June, 1924—an extremely useful record. A comparative table shows that, while there were 458 varieties being tested in 1921, the number had been reduced to 157 in 1924. Another piece of work engaging ROSENFELD's attention was the completion of an exhaustive study of the behaviour in Porto Rico of the POJ seedlings which had proved so useful in resuscitating the industry in Argentina, together with a comparison with their behaviour in the latter country. A report on the subject was prepared for publication in the Journal of the Department of Agriculture. An experiment has also been started for the purpose of getting some light on the known variability of the sugar content of the Uba cane at harvest time in Porto Rico. This has been rendered possible by the co-operation of the manager of the Hatillo Fruit Company, and plots have been laid down with Uba planted at various distances, from very close to widely spaced, on areas sufficient for obtaining accurate tonnage data as well as milling tests. The result of this experiment, which may be carried to second ratoons, should prove of great interest to the growers of this cane variety in the island.

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[1] *I.S.J.*, 1924, 436.

In the Division of Agronomy, P. R. KUNTZ gives details of a number of fresh introductions of cane varieties during the year, chiefly from Cuba, Java and Jamaica apparently; and further facts are added to those already given by the Director concerning the behaviour of recent introductions. The distribution of seed cane is free in Porto Rico, in accordance with a law passed by the legislative assembly. This method has been criticized in the past, in that only too often planters who had neglected the production of their own seed were said to have commandeered large quantities from the Experiment Station, not much caring what varieties were sent them.[1] There appears, however, to be a growing interest on the part of the planters as to the best variety for their local conditions. The quantities sent out are increasing year by year, as is seen from a table for the last five years. Thus in 1920-1921 134 plantations received 1890 bags of seed cane, whereas in 1923-1924 the numbers were 311 and 6930 respectively. Another table gives the relative distribution to the different sections of the island; the north received by far the most, then the west, east and south in decreasing order, while some 25 bags were sent to the interior. KUNTZ explains this by stating that the north and west are more affected by disease, and fresh sound seed is of relatively more importance to them; and, moreover, these two sections are favoured by much greater transport facilities. It is possible indeed for the cane seed to be despatched, received and planted on the same day. The other tracts are not thus favoured, and the seed cane suffers from delays on the journey, so that it not infrequently arrives in a condition unfit for planting. To avoid this miscarriage, he suggests the sending of this valuable and perishable material by express, holding that it would pay to do so. A list is appended of 48 towns to which bags of seed were sent during the year, of which Rio Piedras and Caguas received over one third of 6286 bags. It is also to be noted that each year a certain number of applications have to be held over till the next season; this gives a new set of figures, and in 1923-1924, while 311 applications were satisfied, as many as 232 were left undealt with. Of the varieties sent out, BH 10 (12) and Santa Cruz 12/14 were most in demand; and of the rest D 117, D 1135 and D 109 head the list in this order. It is obvious from all this that the matter of varieties is absorbing a great deal of attention both of the Agricultural Department and the cane planters.

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[1] *I.S.J.*, 1921, 611.

In the Division of Chemistry, F. LÓPEZ DOMÍNGUEZ mentions, as investigations planned for the year, the study of filter-press cake as a fertilizer, manuring experiments with cane, determination of the nutritive value (as far as indicated by chemical analyses) of recently imported forage grasses, and a study of marsh lands of the north coast. All of these are of direct interest to the cane planters. The filter-press cake work is spread over three years and the results will be published after next year's harvest; but the details given for the year show considerable increases in tonnage of canes in the plots thus treated. The cane manuring experiments were concentrated on the rate of maturing of the Uba cane under various manurial doses; the canes were to be cut at 18 months and the juice and ash to be analysed. Seven newly introduced fodder grasses were grown in plots, and analysed at different periods of growth to note the changes in their composition, and finally cut as a crop all together; further analyses were made of them grown as ratoons. A circular is being prepared embodying the results obtained by these analyses, together with notes of their respective powers of growth in the local conditions. The study of marsh lands is important for cane growers of the north coast in that the idea is to reclaim these areas with the object of increasing the area under sugar cane. And here the Station has been fortunate in securing the co-operation of E D. COLÓN, a former Director, who is actively assisting the study at a place called "The Five Hundred Acres," in which he is interested. Levels have been taken, and the amounts and character of the salt complexes of different levels are being investigated, the height of the water table has been determined, reclamation methods are being tested, and a further set of observations are being carried out at the Station laboratory with pot cultures of soil received from the spot.

In the Division of Plant Pathology the new incumbent, MELVILLE T. WHITE, has spent the year in overhauling, and accustoming himself to his surroundings. He finds the laboratory entirely too small for effective work, and has only one assistant which of course is a serious limiting factor. His assistant, R. A. TORO, is reported to be very efficient, but is about to proceed to Cornell University for a course of advanced plant pathology. Much inconvenience is caused by the inadequacy of the postal arrangements, as most of the specimens received are found to be useless on arrival through various delays in transmission. A paper on the present position of plant pathology in the island has already been commented on in this Journal.[1] A record of the most important plant diseases in Porto Rico has been kept, and a summary list of these is given. Under Sugar cane we note the following: red rot (*Colletotrichum falcatum*) common; leaf spot (*Helminthosporium sacchari*) common; leaf spot (*Leptosphaeria sacchari*) very common; rind disease (*Melanconium sacchari*) common and sometimes severe; leaf spot (*Phyllosticta sacchari*) common but not severe; gummosis (*Bacterium vascularum*) very severe in certain localities; mosaic disease very common and in some cases very severe; root rot (*Thielaviopsis paradoxa*) found frequently; dry top-rot (*Plasmodiophora vascularum*) very common and very severe, especially in D 109; Pythium and Rhizoctonia (*Schlerotium Rolfsii*) on record; *Marasmius sacchari* observed frequently but evidently a saprophyte. There is no doubt that there is plenty of work for more than one or two men here. The Division is in charge of many other crops, some of which have received attention; but the main attention has been paid to sugar cane during the year, as this is the major crop in the island.

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[1] *I.S.J.*, 1924, 437.

A special study was made of the effect of mosaic on the tissues of affected sugar cane plants; considerable progress was made in the study of dry top-rot; some of the leaf spots are becoming serious and have received a good deal of attention; and the root rot disease presenting "a most complicated series of problems," is being studied in co-operation with the Division of Chemistry, with special reference to varieties, soil and moisture. Incidentally, it is mentioned that B. A. Bourne,[1] who has done such useful work on root disease in Barbados, has taken up the Professorship of Plant Pathology in the Agricultural College at Mayaguez. This will, doubtless, indirectly strengthen the work of the Division.

G. N. Wolcott, in the Division of Entomology, as usual covers much ground, and various important pests have received attention. In sugar cane the chief work was in connexion with the major pests, white grub and moth borer, but a consideration of these must be reserved for another occasion.[2]

C. A. B.

Crop Production in India.

A Review.

India is a country of paradoxes—to us in the west The splendour of the palaces and the miserable huts of the cultivators of the soil would seem to indicate a greater disproportion in the distribution of wealth than exists in Europe. Money is always available in the former for gala spectacles on a lavish scale, and the ryot may be described in many parts as always on the verge of starvation. But these appearances are somewhat deceptive. Practically all the wealth of India is ultimately derived from agriculture; and, in spite of the unkindness of soil and the pitilessness of the skies over large tracts, there is enough food for all. But, just as the wealthy delight in periodic displays, the poorest cultivator will, on time-honoured occasions, blossom out into unheard of extravagances, even to the extent of placing his services and those of his family in the hands of the money-lender for a long period. And it is this characteristic, call it improvidence if you like, which is the chief cause of the hapless condition of many of the cultivating classes And yet, the economic structure of the country is such that workhouses and poor laws find no place, because there is no need for them. Life with many is merely a gamble with the monsoon. If the rains are good, there is sufficient for all to grow fat, and if it fails, well, it is fate. This very variableness in the seasons has apparently bred into the character of the people this happy-go-lucky system, which to us is so incomprehensible.

"Crop Production" is therefore the key to the whole situation, year by year; and if with the application of western science we can mitigate the effects of a bad season we shall deserve well of the country. Mr. Albert Howard's latest work[3] is devoted to this laudable object; and he studies it by considering the plant growing in the soil rather than from the chemical standpoint. This book furnishes most refreshing reading. During his twenty years of work as Economic Botanist to the Government of India, after careful preparation at Cambridge and considerable experience gained in the West Indies, he has devoted himself steadily to the problem of saving the waste, whether of water, in the soil, or in the kind of plant grown; and no one could be more fitted than he to make a critical survey of the many problems to be solved. The subject is dealt with from the broadest point of view; the chapters are short and pithy; the writing is simple and closely compacted, with a few well chosen examples in illustration; and each chapter concludes with a carefully selected literature. Everywhere there is a notable self-restraint; and, however much he may be interested in any line which he has personally followed out, he never lets himself go. The book, which practically confines itself to work of the officers of the Agricultural Department, formed at the time of his arrival in the country, deals with the more important papers in a perfectly impartial manner; and he discusses the many successes which have been obtained by workers in all fields of enquiry, adding thoughtful suggestions as to the direction along which further research should be attempted. The book is thus of primary interest to the research worker, but it never enters into the intricacies of technical nomenclature, and thus appeals to a much wider circle of readers. Howard's book should be read by every administrative officer in India.

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[1] *Ibid.*, 1923, 514-518. [2] *Ibid.*, 1924, 437.

[3] Crop Production in India A Critical Survey of its Problems. Albert Howard, C.I.E., Director of the Institute of Plant Industry, Indore. (Oxford University Press), 1924. 10/6 net,

The author divides his subject matter into well defined sections. Part I deals with the soil, and five chapters are given to the fundamental problems of drainage, aeration, irrigation, nitrogen content and alkali, easily the most important factors in the soil affecting crop production in India. In all of these subjects he has by his own writings made important contributions. The second section deals with the major crops grown; and here too both he and his talented wife have made valuable additions to our knowledge. After preliminary chapters of a general nature—root development, varieties, seed distribution and fodder—he selects nine crops or classes of crops for special treatment, and concludes with a chapter on the diseases of plants. Part III is only too short and deals with research in a couple of very brief chapters, headed The Ideal Investigator and The Organization of Research. We find ourselves quite unable to point out any particular chapter which strikes us as of outstanding merit. Every bit is worth reading, and, by his method, he retains the interest to the very end.

The chapter on sugar cane has, however, been selected for comment, as illustrating the author's method and general outlook, because it is more likely to be of interest to the readers of this Journal; although it is recognized that it is practically impossible to do it justice either as regards the style in which it is written or its contents. The chapter commences with a brief statement of the unsatisfactory position of the Indian sugar industry, in that notwithstanding the close on two and three-quarter millions of acres under the crop it is necessary to import large quantities of sugar into the country. This is due in the main to the low standard of production. The distribution of the cane areas in India is considered, and the curious fact is noted that, while excellent crops of tropical canes can be grown in the peninsula, 75 per cent. is raised in the Indo-Gangetic plain north of the Tropic of Cancer. The reason given for this is the ingrained preference of the southern cultivator for rice where irrigation is available; and the author suggests that the scientific basis for this preference has not as yet been adequately explored. Be that as it may, it is obvious that any attempts at increased production should be concentrated on north India; and the limiting factors of this tract are duly set forth. These are, firstly, the general absence of a cheap source of irrigation during the early stages of the plant's life, coupled with the low atmospheric humidity there. The cane is planted in February but, not until June, when the rains break, does growth really commence. Meantime the plants are establishing themselves, and the cultivator aims at assisting them in this by one close planting of hardy narrow-leafed forms. The kind of cane is thus a second limiting factor. Growth once started is extremely rapid, but in November the winter commences and it ceases, this short growing period providing a third inhibiting factor. It is thus easy to explain the low yield per acre in India when compared as it often is with countries like Java or Cuba.

The author speaks with approval of the monumental Report of the Indian Sugar Commission[1] which, while he cannot agree with all its conclusions, forms an admirable starting point for further work. He specially singles out the chapter dealing with the Java sugar industry,[2] and draws especial attention to the successful aeration of the soil and saving of irrigation water in the fields. Incidentally, he mentions that besides the European plantations there exists an indigenous sugar cane cultivation, and that the crop production in this is practically that obtained in India by the cultivator in spite of his disadvantages. "This fact" he adds "is significant, and suggests that in addition to example, active propaganda will always be needed in developing agricultural production in the Orient."

The general line of advance appears to be to increase the production of cane and juice per unit area, at the same time reducing the cost per ton of cane grown. This can be achieved by the substitution of more efficient varieties and, still better, by intensive cultivation of such improved forms. This introduction of improved varieties is contingent on a thorough survey of those existing, together with the conditions in which they are grown. Although some useful work has already been done at Coimbatore and elsewhere, such a survey is far from complete, and in it the root systems have so far been omitted. Here again a commencement has been made at Coimbatore (but presumably such work should be done in the tract where the canes are growing). Improved varieties are now forthcoming through the work at Coimbatore, and the forms specially mentioned with approval are those which have been obtained by crossing the wild grass *Saccharum spontaneum* with an acclimatized thick cane of south India. Yet another source of new varieties is available from Shahjahanpur Experiment Station, where pure lines have been selected from the indigenous mixtures, and forms have also been introduced from other sugar cane countries; and some of these are spreading in the districts. But, for the best results, this substitution should be accompanied by the intensive cultivation of such improved varieties. This is obviously beyond the scope of the Coimbatore Breeding Station and has to be carried out in the tract itself; and much progress has been made at Shahjahanpur, where the whole scheme of improved agriculture has been worked out carefully for some years.

The basal needs of the sugar cane in India are a source of combined nitrogen, moisture, and adequate aeration of the soil. The former is difficult in India, for, while all indications appear to point to some form of oil cake as the most useful nitrogenous manure for the sugar cane, the supply of this is distinctly limited; and the pressing of oil seeds (as explained in another chapter) in India on a large scale is hardly a commercial proposition. But work at Manjri in Bombay and especially at Shahjahanpur has added a good deal to our knowledge of getting round this difficulty. At the latter station it has been found that 100 lbs. of nitrogen given once in four years will produce, with irrigation, a threefold yield of sugar cane, besides adding largely to the crops of wheat, gram and fodder grown in the rotation.

The water requirements of the sugar cane have not as yet been adequately explored in India, although it is generally believed that the cultivator habitually over-irrigates if he has the chance. At Shahjahanpur the Java method has been tried experimentally, and it has been found that, during the growing period (June to November ?), only three of four irrigations are needed, which is distinctly interesting. A study of soil aeration is closely connected with that of the root system, and this has as yet hardly been touched. There are many similar facts and suggestions scattered through this chapter of nine pages, but only one more can be given as an illustration. The author regards it as not impossible that the new seedlings required may be raised in the tract itself. The present bar is that, even if the cane flowers, its stamens are imperfectly developed; and he proposes that an experiment should be made in growing the plants under glass, as he considers it possible that under such conditions fertile flowers may be produced. (This experiment appears to be worth trying, although difficulties will probably occur in growing on the young seedlings in the north Indian climate).

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[1] *I.S.J.*, 1921. 554.

[2] *Ibid.*, 493.

It is natural that HOWARD deals primarily with north India, where his sphere of work has been located, mainly in the great Indo-Gangetic alluvial plain. The writer of this review has always felt that it was a dangerous experiment on the part of the Government to fix the all-India Research Institute at Pusa, which is situated in Bihar and many miles outside of the tropics. And he has sometimes wondered what the result would have been if a more central position had been chosen, say, equally within reach of the great plains of north India and the Deccan with its bordering tropical coastal fringes in Bombay and Madras. But in view of the great success attained by this Institute it is impossible to find much fault with this selection at the present time. One happy result has unexpectedly emerged; and that is that the various heads of sections, whether chemical, botanical, entomological, mycological or agronomic, have in succession found themselves entirely unable to cope at the same time with northern India, and the entirely different crops and conditions of the tropical peninsula. And this has led to the unimpeded development of the great research and teaching colleges of Bombay, the Central Provinces and Madras, in all of which signal successes have been attained in the improvement of crop production.

But this limitation does not detract from the value of the book. The problems may have to be approached from a somewhat different point of view in the peninsula, and this difference would be emphasized by the examples given in illustration; but the broad principles are the same, and it will be easy for workers all over India to apply them to the elucidation of their own problems, especially as almost all of the most important work done in the south is duly referred to and recorded in the lists of literature. One would, however, have welcomed a chapter on the millets—a rather bewildering subject, on which many pieces of work have been commenced. In the nature of the case, this section of crop production is at present in an inchoate state, and some leading ideas from the author would doubtless have helped to bring matters into a proper perspective, if he had had the opportunity to gain a first-hand knowledge of the local conditions and problems involved. The millets of the peninsula take the place of wheat in the north, as the dry cereal food of the people; and such careful work as that of COLEMAN in Mysore, although outside of the Indian Agricultural Department, would then have found a deserved place in the book. Similarly, we think that the dry-farming of the Deccan, although referred to, is deserving of a separate chapter to itself—a unique example of the evolution of agricultural practice by the Indian cultivator when faced with, to us, almost impossible conditions. But these cases are not mentioned in any way in disparagement of the book, but merely to indicate, by an example, the vastness of the subject. Now that HOWARD's new location more nearly approaches geographically our ideal for an all-India research station, it may be hoped that he may be led by personal experience to give us at some future time his ideas on these vital south Indian problems.

It is the unhappy duty of the reviewer of a book to carefully note down any inaccuracies which occur in the text. Thus far only one slip has been detected.

In the chapter on oil-seeds, a list of major crops is given, including Sesamum, while *gingelly* finds its place among the minor crops producing this substance. This slip has obviously escaped the author's vigilance, for *gingelly* is the vernacular name in south India for Sesamum.

C. A .B.

Discovery of the Presence of Vitamins in Cane Molasses.

By J P OGILVIE, F I C.

It has hitherto been held by most chemists and physiologists that sugar products owe their value as foods only to the number of calories they are capable of producing when consumed in the animal organism. But some recent work carried out by the American investigators, Messrs. V. E. NELSON, V. G. HELLER, and E. I. FULMER,[1] of the Iowa State College, Ames, Iowa, U.S.A., seems to establish definitely that cane molasses is of value as human food and as cattle fodder for another very important reason, namely that it contains vitamins, not to any comparatively insignificant extent, but in such amount as to induce these chemists to consider "blackstrap" as a suitable source of one of these remarkable substances.

WHAT VITAMINS ARE.

Vitamins are chemical bodies existing in extremely small quantity in most natural foods, which have been shown without any doubt to exert a most important effect on the health of the animal organism. They do not appear to have been isolated in the pure state, nor does their constitution or composition appear to have been established. When they are absent from food, certain "deficiency diseases," such as scurvy, beri-beri, rickets, and polyneuritis, may be produced; and when they are present in insufficient amount, the growth of the young animal may be diminished or arrested. If the inadequate supply is continued, death may ensue, no matter how rich in carbohydrates, fats, proteins and salts, and no matter how plentiful the diet consumed may have been.

These vitamins, or "accessory food factors" as they are called, are present in flesh foods, milk, butter, cream, cheese, eggs, wholemeal bread, yeast, vegetables, and fruits; but they are absent from white flour, most refined vegetable fats (as used in margarine manufacture), corn-flour, starch, polished rice, "pearled" barley, wheat, jams, refined sugar, etc [2]

Three vitamins are known: (1) Fat-soluble Vitamin A, which exists in cod liver oil, butter, and some other fats, to which class of foods it is, however, not confined. In its absence young animals cease to grow, and die after a time. (2) Water-soluble Vitamin B, which is present in whole-grained rice, peas, beans, tomatoes, yeast, etc. Its absence is the cause of beri-beri, and similar "wasting" diseases. (3) Water-soluble Vitamin C, present in fruit and green vegetables, these being relatively rich in it. A prolonged deficiency of this "factor" brings on scurvy and like maladies. It is to be noted that vitamins are sensitive to heat, A moderately so, C particularly so, and B least of the three.

DISCOVERY OF VITAMIN B IN CANE MOLASSES.

Since vitamins cannot be determined by any known analytical process, the only means available for revealing their presence is the biological method, which involves observation of the condition of small animals and their young under carefully controlled conditions of diet containing (or not containing) the food material under observation.

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[1] *Industrial and Engineering Chemistry*, 1925, 17, No. 2, 199-201.

[2] Refer to "Vitamins," by RAGNAR BERG (Geo. Allen & Unwin, Ltd., London), 1922, p. 221, also to "The Vitamins," by H. C. SHERMAN and S. L. SMITH (Chemical Catalog Co., Inc., New York), 1922, pages 182-183.

In the experiments made by the authors cited above, rats were placed on a series of diets, which were complete in respect of carbohydrate, fat, protein and salt contents, but were free from Vitamin B. To one of this series, cane molasses was added, to another beet molasses, to another sorghum syrup, and to the last no further addition was made.

In this way, cane molasses was proved to be rich in Vitamin B, much richer indeed than beet molasses or sorghum syrup. Using 10 per cent. of cane molasses, a considerable number of young animals were weaned, and in fact these animals were carried through the third generation with this amount of addition, and through the fifth with 15 per cent. of it. But, using 10 per cent. of beet molasses, all the young of the first generation died before they were weaned, and even 25 per cent. failed to produce a satisfactory growth. This effect has proved not to be a toxic one (as the reader may have surmised was the case), as the addition of 5 per cent. of yeast (which is rich also in Vitamin B) caused resumption of growth immediately. As to sorghum syrup, the animals declined after only one month's feeding on a diet containing it, and that this failure in growth was due to a deficiency of Vitamin B was proved in the same way, namely, by adding some yeast to the diet, and observing the renewal of the vitality of the animals.

Comparison of these results with previous ones carried out by the authors cited[1] showed that cane molasses gave better results in the reproduction and rearing of the young animals, in the number of litters and of young to each litter, and very much better results in the rearing of these litters, than did yeast, which has hitherto been held to be a good source of Vitamin B.

SIGNIFICANCE OF THESE RESULTS.

These results, especially if confirmed by other investigators, will probably be of interest in view of the already wide use of molasses in human diets and in animal foods. Cane molasses will in consequence doubtless be considered as a suitable source of supply of Vitamin B in the dieting of infants and young children, who (medical authorities decree) must be well supplied with all three accessory substances. This discovery made by the American chemists will surely also enhance the value of molasses and table syrups as a food for heavy manual workers, the working classes generally, athletes, soldiers, and others. Further, it may be considered by some as an argument in favour of West Indian Yellow Crystal sugars and similar molasses-containing, palatable cane sugars, especially in feeding the young. No one of any sense, however, will use this argument against the general use of refined sugars.[2] In the case of adults, their vitamin requirement is probably much less than in that of children, and, any way, their range of choice of suitable vitamin-containing foods is greater. Lastly, no doubt, the discovery will induce the scientific farmer and animal breeder to specify cane molasses as an addition to the saccharine fodders used by them. Altogether, therefore, these experiments may be of not a little interest to many connected with the cane sugar industry.

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[1] *Science*, 1922, 56, 650.

[2] In any event, controversy between parties representing refining and direct consumption interests is much to be deprecated, and is not likely to assist the interests of either side. It is. for example, particularly fallacious to use the results of the experiments of Messrs. NELSON, HELLER, and FULMER, as an argument for avoiding (if it were possible) the consumption of refined sugars, as some may indeed attempt to do. It seems equally unfair to allege (as has been done) that white unrefined sugars are unwholesome, seeing that many thousands of tons of this grade of plantation sugar are now annually consumed in different countries with no other than a satisfactory result.

Hydrogen-ion Concentration in Cane Sugar Factories.[1]

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The measurement of hydrogen-ion concentration has received much attention in recent years, especially in the biological sciences. A very complete description of the subject, both in regard to its theoretical and practical considerations, has been given by CLARK[2]; but to the writer's knowledge BREWSTER and RAINES[3] were the first to apply the subject to cane sugar factories. The question of hydrogen-ion concentration (*pH*) intimately affects the working of cane sugar factories, since clarification, colloid precipitation, colour, inversion of sucrose are largely governed by this factor.

During the last two years the writer has had occasion to visit different sugar producing countries, and has made some *pH* measurements in various factories. Hitherto, with a few exceptions, BREWSTER and RAINES,[4] GEBELIN,[5] GEBELIN and WILLIAMS,[6] DODDS[7] and MCALLEP,[8] few have communicated information about the *pH* in cane factories of different countries. It is hoped that when the valuable indicators of CLARK and LUBS are more extensively used by sugar chemists there will be more data available on this subject.

THE COLORIMETRIC DETERMINATION OF *pH*.

BREWSTER and RAINES[4] have described the "spot plate" method of *pH* determination, using buffer solutions and Clark and Lubs' indicators. The writer has employed the same method, but prefers to dilute the solution to be examined, after which it is possible to compare the indicator colour directly with the well-known colour charts of CLARK. With "buffered" solutions such as cane juices which contain protein, amino-acid, amides, phosphates, etc., it is possible to dilute as much as five-fold without appreciably altering the hydrogen-ion concentration, particularly if this is in the neighbourhood of *pH* 7.

The following procedure is very simple, and with cane juices determines the *pH* within 0·2 of that given by the standard electrometric method :—2 c.c. (approximately) of cane juice or the like are diluted to 10 c.c. (approximately), using water of *pH* 7 ; 0·5 c.c. of the appropriate indicator solution is added, and the solution is directly compared with the colour chart. A 10 c.c. graduated cylinder is very useful for measuring the juice and dilution water.

Table I gives the indicators of Clark and Lubs, their concentration, colour change, *pH* range, and application in sugar factories :—

TABLE I.

	Per cent.		*pH.*	
Thymol blue	0·04	.. Red-yellow . .	1·2–2 8	
Brom-phenol blue..	0 04	.. Yellow-blue.. .	3·0–4·6	Sulphured juice.
Methyl red	0 02	.. Red-yellow	4·4–6·0	Sulphured juice, raw juice.
Brom cresol purple .	0·04	. Yellow purple ..	5·2–7·0	Clarified juice.
Brom thymol blue..	0 04	.. Yellow-blue....	6·0–7·6	.. Raw juice, clarified juice, etc.
Phenol red	0·02	.. Yellow-red	6 8–8·4	.. Clarified juice, alkaline juice.
Cresol red	0 02	. Yellow-red	7·2–8·8	.. Clarified juice, alkaline juice.
Thymol blue	0 04	. Yellow-blue.. .	8·0–9·6	.. Alkaline juice.
Litmus............	—	.. Red-blue	5 0–8·0 ..	—
Phenolphthalein ..	—	Colourless red ..	8·3–10 0	—

In sulphitation and defecation factories a *pH* of 10 is seldom exceeded; but in carbonatation factories the *pH* of the first carbonated juice lies between *pH* 11 and *pH* 12. This *pH* can be approximately determined with "Alizarine V. 1."

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[1] Published with the kind permission of the Association.

[2] CLARK "The Determination of Hydrogen Ions." Second Edition. 1922. (Williams & Wilkins Co., Baltimore, U.S.A.) [3] BREWSTER and RAINES, *I.S J.*, 1923, 25, 88.

[4] *Loc. Cit.* [5] GEBELIN, *Louisiana Planter*, 1923, 172.

[6] GEBELIN and WILLIAMS, *Facts about Sugar*, 1923, 17, 202.

[7] DODDS, *South African Sugar Journal*, 1924, 8, 489. [8] MCALLEP, *I.S.J.*, 1924, 26, 143.

The *pH* of Sugar Factory Products.

On determining the *pH* by the colorimetric method already described, an extraordinary regularity was found in the *pH* of the juices in most of the factories. Although of course the figures at different factories, and in different countries varied somewhat one from another, yet individually there was practically no variation; never more than 0·2 *pH* on different days.

Table II gives some *pH* figures in a few defecation factories in the British West Indies; Table III the *pH* in Natal sulpho-defecation factories; Table IV the *pH* in Mauritian sulpho-defecation factories, and in addition the *pH* in a Natal carbonatation factory is given in Table V. Table VI includes figures for a Natal sulphitation factory working the Bach process, and also for a defecation factory in Trinidad using the Bach process on melted sugar liquor in a "refinery" attached to the raw sugar factory.

Table II.

Factory Defecation.	Raw Juice.	Limed Juice	Clarified Juice	Alkaline Juice from Filter-press	Syrup.
Trinidad, B.W.I.—					
Usine Sainte Madeleine	5 4	7·2	6·9	—	6·8
Jamaica—					
1. Amity Hall	6·1	7·6	7 2	7·8	7·2
2. Serge Island	5·8	6·6	6·4	—	6·5
3. Bernard Lodge	5 8	6 8	6 7		6·6
4 Gray's Inn	5·6	6 5	6·3	—	6·3

It will be seen that the *pH* of the raw juice varies considerably. It is higher in Mauritius than in Natal. Any *pH* figures below *pH* 5 for raw juice are probably abnormal and due to fermentation. But there is a big fluctuation between *pH* 5·0 and *pH* 6·3. We know little about the effect of environment upon the *pH* of the juice of sugar cane.

It is interesting to compare the average *pH* of the juices, etc., in the sulphitation factories of Natal and Mauritius, in which countries the system of white sugar manufacture is much the same. In general Natal is more acid in its method of work; there is a slight difference in the *pH* of the (cold) limed juice and a larger difference in the *pH* of the clarified juices of the two countries; the amount of "muds" in the Uba juice of sub-tropical Natal is far greater than in the Mauritius juice,[1] and the filter-press area in Natal is relatively three times as great as that in Mauritian factories.

Table V.

Factory. Carbonatation.	Raw Juice	First Carbonated Juice	Second Carbonated Juice.	Clarified Juice.	Syrup	
					Before SO_2	After SO_2
Natal—						
Mount Edgecombe	5·4	11·5	7·8	6·2	6·2	5·8

Table VI.

Factory Bach Process.	Raw Syrup.	Limed and Sulphured Syrup.	Same after heating 100°C	Same after filtering	Sulphured Syrup going to pan
Natal—					
Verulam	6 2	6·1	6·1	6·1	4·9

	Melted Raw Sugar.	Limed and Sulphured Liquor	Same after heating 95°C	Same after filtering	
Trinidad—					
Usine Sainte Madeleine— Bach process used on melted raw sugar	6 8–7·0	6·8	6·7	6·7	No final sulphuring.

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[1] See Farnell. Report on further investigations of cane colloids.

TABLE III

FACTORY	Raw Juice.	SULPHURED JUICE		Limed Juice.	Clarified Juice	Alkaline Juice from Filter-press	SYRUP		NATURE OF SYRUP TREATMENT.
SULPHO-DEFECATION. *Natal*— (Uba juice, white sugar.)		*pH*	Grams SO_2 per litre				Leaving Evaporator	After Treatment	
1. Verulam	5·4	3·8	1·5	6·9	6·4	7·1	6·2	5·0	Bach process. (see Table VI)
2. Tinley manor	5·2	3·7	2·0	7·0	6·4	10·0	6·4	—	No syrup treatment.
3. Felixton	5·4	3·8	—	6·7	6·6	8·8	6·4	5·2	Syrup sulphured.
4. Empangeni	5·5	3·8	—	7·0	6·6	8·2	6·5	—	No syrup treatment.
5. Tongaat	—	—	—	—	6·3	6·8	6·2	—	No ,, ,,
6. Maidstone	5·6	4·8	—	6·9	6·4	8·7	6·4	—	No ,, ,,
7. La Mercy	5·4	4·5	—	7·5	6·2	6·2	6·2	—	No ,, ,,
8. Renishaw	5·5	4·2	—	6·6	6·4	—	6·1	—	No ,, ,,
9. Sezela	5·3	3·5	—	6·8	6·5	9·6	6·6	—	No ,, ,,
10. Esperanza	5·5	4·0	—	—	6·3	—	6·2	4·8	Syrup sulphured
11. Gledhow	5·6	5·2	—	—	6·5	—	6·4	—	No syrup treatment.
12. Illova	4·8	3·6	1·6	6·8	6·3	7·4	6·3	—	No ,, ,,
(Raw Sugar.)									
13. Darnall	5·4	3·5	1·2	6·5	7·2	9·2	7·2	—	No syrup treatment.
14. Amatikulu	5·4	3·5	1·1	6·9	7·5	8·4	7·3	—	No ,, ,,
Average	5·4	4·0	1·5	6·9	6·5	8·3	6·5	5·0	
Average, excluding raw sugar factories 13 and 14	5·4	4·1	1·7	6·9	6·3	8·2	6·3*	5·0	

* The average figure for the *pH* of the syrup going to the pan (including both treated and untreated) is *pH* 5·9.

TABLE IV.

FACTORY. SULPHO-DEFECATION. *Mauritius*—	Raw Juice.	SULPHURED JUICE		Limed Juice.	Clarified Juice	Alkaline Juice from Filter-press.	SYRUP.		NATURE OF SYR TREATMENT.
		pH.	Grams SO_2 per litre				Leaving Evaporator.	After Treatment.	
1. Highlands	5·6	3 8	—	6·8	6·6	7·6	6·6	6 4	Syrup sulphured.
2. Britannia	6·3	3·8	1·6	6·8	6·6	8·3	6 5	6·5	Syrup boiled, sett
3. Mon Desert*	5·5	3·6	1·0	6·7	6·4	—	6·2	6·2	P_2O_5 to syrup.
4. Trianon	6·1	3·7	1·2	6·6	6·2	9·6	6·6	6·0	P_2O_5 ,,
5. Gros Bois	5 6	3·8	1·0	6·8	6 7	8 8	6·4	6·1	P_2O_5 ,,
6. La Baraque	5·6	4·0	1 0	7 1	6 7	—	—	—	
7. Savannah	5·3	3·7	1·0	7·0	6·8	9·0	6·6	6·4	P_2O_5 to syrup.
8. Alma	5·5	4·2	0·9	6·6	6·7	9·6	6·4	—	No syrup treatment.
9. Labourdonnais	6·3	4·3	0·8	7·1	6·5	6 8	6·6	—	No ,, ,,
10. Richfund	6·3	4·4	0·7	6·7	6·6	8·3	6·5	6 0	P_2O_5 to syrup.
11. Union (Flacq)	6·0	3·6	0·7	7·4	6 6	7·6	6·6	6·2	P_2O_5 ,,
12. Reunion	5·5	3·8	0·9	7·3	6·7	6·6	6 5	6·0	P_2O_5 ,,
13. Rose Belle	6·2	3·8	0·9	6·7	7·0	—	6·7	—	No syrup treatment.
14. Bon Air	6·2	4 6	—	7·0	6·8	—	6·8	6·3	P_2O_5 to syrup.
15. Grande Rosali	6·3	4·0	0·8	7·6	7·1	7·8	6·7	6 1	P_2O_5 ,,
16. Beau Sejour	5·6	3·6	—	6 7	6·2	6·2	6 2	6·2	No syrup treatment.
17. Bel Ombre	5·6	3·6	1·3	6·9	6·6	8·2	6·5	6·2	P_2O_5 to syrup.
18. Bel Air	5·6	4·0	—	6·7	6·2	10 0	6·2	6·0	P_2O_5 ,,
19. Medine	6·2	4·6	1·1	7·0	7 0	7·6	6·9	—	No syrup treatment.
20. Sans Souci	5·3	4·1	0·9	7·3	7 0	7·8	7·0	—	No ,, ,,
21. Constance	5·5	3·8	1·0	7·0	6·5	6·8	6·2	—	No ,, ,,
22. Riche-en-eau	6·1	4·2	0 8	6·8	6·4	7·3	6·3	5 1	P_2O_5 to syrup.
23. Beauvallon	6·2	3·8	1 8	7·0	6·8	10·0	6·5	6·3	P_2O_5 ,,
24. Plaisance	5·5	4·4	—	7 3	6·5	8 0	6·5	5·8	P_2O_5 ,,
25. Ferney	6·1	4·0	1·0	7·0	6·8	7·8	6·7	—	No syrup treatment.
26. Mon Desert†	5 7	4·1	1·2	7 0	6·6	7·6	6·2	6·2	Syrup sulphured.
27. Saint Antoine	5·7	4·3	0·9	7·1	6·6	7·4	6·6	—	No syrup treatment.
28. Mount	5·6	4·2	0·9	7·0	6·6	8·0	6·6	—	No ,, ,,
29. Belle Vue‡	6·2	4·6	—	6·6	6 3	8·0	6·4	—	No ,, ,,
30. Le Val	5·2	4·0	0 8	7·2	6·9	8 1	6·6	6·4	P_2O_5 to syrup.
31. Argy	5·6	4·1	—	6·4	6·4	7·7	6 3	—	No syrup treatment.
32. Beauchamp	5·3	4·1	—	7·1	6 7	7·2	6·6	—	No ,, ,,
Average	5·8	4·0	1·0	7·0	6·7	8 0	6·5§	6·1	

* Moka † Carie. ‡ Hariel.

§ The average figure for the *pH* of the syrup going to the pan (including both treated and untreated) is *pH*

The Natal Uba juice is more "buffered" than the juice of Mauritius. In both countries there is an increase in hydrogen-ion concentration between the cold limed juice and the hot clarified juice. The average decrease in *pH* is 0·6 *pH* for Natal (limed juice *pH* 6·9, clarified juice *pH* 6·3), and 0·3 *pH* for Mauritius (limed juice *pH* 7·0, clarified juice *pH* 6·7). The increase in hydrogen-ion concentration is probably due to the coagulation of some of the albumen on heating. The albumen is the principal "buffer" in the cane juice, and when it is removed there is a greater dissociation of the acids in the juice and its *pH* sinks. This drop in *pH* was not observed when hand-crushed cane juice was sulpho-defecated. The amount of albumen is much less in this case than in the juice from a factory cane mill where there is a much greater rupture of the cell walls, with consequent extraction of protoplasm.

WALTON, MCCALIP and HORNBERGER[1] have found "little, if any" inversion during the sulpho-defecation process when the sulphured juice is limed back to *pH* 6·9. This should apply then to most of the factories of Natal and Mauritius. BREWSTER and RAINES[2] find that under Louisiana conditions there is an optimum flocculation of the impurities in the juice on liming back to *pH* 6·8–7·0. The same conditions hold good apparently for Natal and Mauritius.

Hitherto no work appears to have been done on the subject of inversion in syrups. The effect of *pH* on the inversion of syrup is receiving attention in Mauritius by BAISSAC.[3] The question of temperature seems to be more important than the hydrogen-ion concentration in determining inversion. Above 80° C. there seems to be a rapid increase in the rate of inversion even at such slight acidity as *pH* 6·5.

THE QUINHYDRONE ELECTRODE.

A preliminary trial has been made with this simple apparatus. For certain purposes it appears very satisfactory and its use may be extended to sugar factories working simple defecation.

A description of the quinhydrone electrode is given by CLARK.[4] Our knowledge of the electrode is mainly derived from the researches of BILLMANN and his co-workers[6], [7], [8]. BILLMANN has applied the electrode to the determination of the *pH* of soils [9], and HARRIS has introduced it in the analysis of mixtures of amino acids, products of protein degradation [10], [11].

The quinhydrone electrode has many advantages over the hydrogen electrode, being as accurate for many purposes and considerably quicker in attaining equilibrium. Its chief advantage, however, is the possibility of dispensing with hydrogen, not easily obtainable in some tropical countries.

The electrode consists of a piece of blank platinum foil which is suspended in the solution to be examined which is in equilibrium with solid quinhydrone. A saturated calomel half-cell is coupled with the quinhydrone electrode and the E.M.F. can be read off at once. It is only necessary to use a few centigrams of quinhydrone for saturating the solution.

The juice, cooled to 30° C. or less, passes through the inlet tube *F* into the vessel *A*, which contains crystals of quinhydrone *Q*, resting on a wad of glass wool *W*; the juice, saturated with quinhydrone, enters the lower vessel *B*, in which there is a gold or platinum electrode *P*. Finally, the juice overflows through *G*; a bridge is formed through *H* with the saturated calomel half-cell *D*, and the

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[1] WALTON, MCCALIP and HORNBERGER, *I.S.J.*, 1924, 26, 312.

[2] BREWSTER and RAINES, *I.S.J.*, 1923, 25, 88

[3] Private communication.

[4] "Determination of Hydrogen-Ions." Second Edition; pp. 289-293.

[6] BILLMANN, *Ann. Chim.* 9, 1921, 15. 109.

[7] BILLMAN and LUND, *Ann. Chim.* 1921 9, 16, 321

[8] VIEBEL, *J. Chem. Soc.*, 1923, 2203 T.

[9] BILLMAN *J. Agric Sci*, 1924, 14, 232.

[10] HARRIS, *J. Chem Soc.*, 1924, 3294 T.

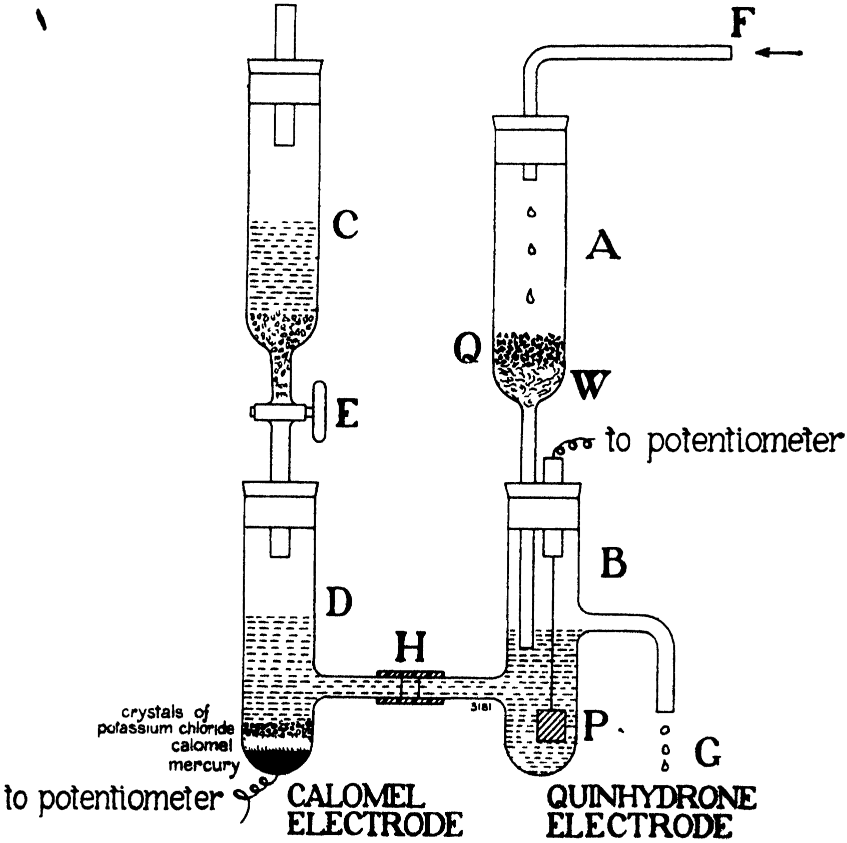
[11] HARRIS, *Proc. R.S.*, 1923, 95, 440; Series B, No. B. 670.

E.M.F. can be measured by the recording potentiometer (not shown). Periodically it is necessary to introduce fresh saturated potassium chloride solution into *D* from *C* by turning the tap *E*.

At 25° C. using a quinhydrone electrode and a saturated calomel half-cell the *pH* is given by the following expression in which *Eh* is the observed E.M.F. in volts:

$$pH = \frac{0{\cdot}453 - Eh}{0{\cdot}059}, \text{ or } pH = 7{\cdot}68 - \frac{Eh}{0{\cdot}059}.$$

Above *pH* 7·68, *Eh* becomes negative and must be added to 7·68, instead of subtracted. Above *pH* 8 the system is unreliable, but in ordinary defecation factories this *pH* is seldom reached, except by the alkaline juice from the filter-presses. Unfortunately in the presence of strong reducing agents, such as either free sulphurous acid or sulphites the electrode is useless, and its application to sulpho-defecation factories is therefore ruled out.



The quinhydrone electrode can be adapted for continuously recording the *pH* of a changing solution, such as the clarified juice of a defecation factory. The arrangement used is outlined in the rough sketch appended.[1]

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[1] The apparatus was made by the Cambridge Instrument Co., Ltd., 45, Grosvenor Place, London, S.W.1., who kindly prepared the illustration shown.

Colloids in Cane and Beet Sugar Manufacture.[1]

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INTRODUCTION.

It is now generally recognized that the clarification of cane and beet juices as ordinarily practised involves primarily the elimination of colloids by such typically colloidal mechanisms as adsorption and flocculation, and that the amount of non-sugar compounds eliminated as a result of unmodified chemical reaction is relatively small. Nevertheless, the extent of the existing quantitative colloidal data pertaining to this industry is extremely limited.

Colloidal investigational methods should be approached with a degree of conservatism, inasmuch as the general principles so far established largely fail in the case of the more highly solvated hydrophile colloids, which are the typical colloids of nature, and also no doubt the ones most difficultly eliminated in the clarification of cane and beet juices, hence those which cause most difficulty in later stages of factory procedure.

It is unfortunate that a number of experimental procedures which are very useful in the study of hydrophobe colloids are of little value in the investigation of typical hydrophiles. For instance, ultramicroscopic examination of the latter is limited in value because of poor definition resulting from the extremely small size of micellæ or slight difference in refractive index between the disperse phase and dispersing medium. Also, the electric behaviour of hydrophile colloids is not well defined. Colloids at various stages of transition between the most typical hydrophobe and hydrophile conditions are no doubt to be encountered in both cane and beet products and the applicability of various investigational methods must therefore be decided rather specifically in each case. It is also to be kept in mind that any given colloidal condition may be merely transitory and subject to variation within wide limits. The subject is evidently complex.

In addition to information regarding the qualitative behaviour of the colloids present in beet and cane products, it is desirable to obtain a quantitative measure of the colloidal material (within rather definite dispersion limits) under various conditions and particularly at successive stages in factory processes as a criterion of the efficiency of different processes from the standpoint of colloid elimination. The value of the quantitative data is dependent upon adequate information regarding the qualitative behaviour of the predominant colloids, and investigation of cane and beet colloids should be pursued from both standpoints simultaneously. In using the term "colloids" it is well to stress the fact that included within its scope are a number of compounds which have already been investigated from other standpoints and which are now grouped under this generic designation as an abbreviated method of indicating certain common properties dependent largely upon degree of dispersion.

The writers have undertaken a somewhat systematic investigation of the subject here outlined and some initial results are presented in this paper. A number of investigational methods and criteria were employed; the following comments are made regarding their probable practical value. In this paper the terms "emulsoid" and "suspensoid" will be used synonymously with "hydrophile" and "hydrophobe."

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[1] Paper (here slightly abridged) presented before the Division of Sugar Chemistry, American Chemical Society, at the 68th Meeting of the American Chemical Society, September 8th to 13th, 1924. (Already briefly abstracted *I.S.J.*, 1924.)

INVESTIGATIONAL METHODS AND CRITERIA.

Dialysis, Ultrafiltration, and Centrifugation.—These procedures are available for approximate quantitative separation from the dispersion medium of colloids at fairly definite degrees of dispersion. Centrifugation has the advantage of making possible a fractional separation by careful control of speed and other factors; but, on account of the very high speeds required, is impracticable for separation of highly dispersed colloids. It has very little value for separation of typical emulsoids. Dialysis[1] by use of collodion sacs was investigated by one of the writers (PAINE[2]) in 1920; and, so far as known, he was the first to apply the method to the approximate separation of beet and cane colloids. This procedure is very difficult to control, however, and the results obtained can be regarded only as approximate. Continued investigation of the subject has shown that ultrafiltration is preferable to dialysis for quantitative colloid separation. Standardized ultrafilters have been developed by L. E. DAWSON of this laboratory, and most of the initial colloid separations here described have been made by the use of these ultrafilters. The residual colloidal suspension in water obtained after completion of ultrafiltration is evaporated and dried at a low temperature and then weighed. In the case of both dialysis and ultrafiltration, a certain degree of change in dispersion occurs during the operation. This fact may vitiate to some extent the absolute value of ultrafiltration data. Standardized ultrafilters, however, have distinct comparative value.

Water Reversibility and Water Irreversibility.—The dried and weighed ultrafiltration residue is separated by treatment with water into two portions, one reversible and the other irreversible, and the weights of the two portions are determined after drying at low temperature. The two fractions are usually distinctly different in appearance, composition, and weight, and their relation to each other in these respects varies decidedly in different factory products, depending upon the stage of the process. The water-reversible portion exhibits the typical properties of emulsoid colloids and for practical purposes may be regarded as identical therewith. The water-irreversible portion is of more typically suspensoid than emulsoid character, but it may also represent intermediate stages between typical emulsoid and suspensoid conditions. Colloids such as silicic acid and various organic compounds, which are dehydrated or denatured when dried, do not wholly reverse in water, and yet are originally of emulsoid type. To this extent the irreversible fraction involves emulsoids and their typical properties, such as viscosity. It should be recognized that the proportion of typical suspensoids present in such products as cane juice and beet juice is, at most, relatively small. One of the most distinctive differences between the colloids present is probably that of degree of solvation. The terms "suspensoid" and "emulsoid" are here used as a matter of convenience, but with the reservations as to meaning indicated above.

Flocculation of a portion of both cane and beet colloids occurs during the course of ultrafiltration (also during dialysis) under the influence of the withdrawal of sugars and electrolytes. Sucrose apparently has a stabilizing influence[3] on certain colloids. This group of colloids, which is flocculated during ultrafiltration, is almost entirely included in the water-irreversible fraction. This test of reversibility, while not scientifically specific, is for practical purposes one of the most valuable of all available criteria, since the colloids which are primarily responsible for increased viscosity are of pronounced emulsoid type. The procedure may also be employed for separating a quantity of emulsoid colloids for further investigation.

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[1] FARNELL, *I.S J.*, 1924, 26, 420, has recently used this method for separation of cane colloids.

[2] PAINE, CHURCH, and REYNOLDS, unpublished report, "Colloids in Beet Sugar House Liquors," circulated to beet sugar companies in the United States, April, 1921.

[3] ANDERSON, *Trans. Faraday Soc.*, 1924, 19, 635, noted a definite peptizing effect of sucrose upon colloidal gold.

Surface tension.—Pronounced influence on surface tension (designated as σ) is particularly characteristic of minute proportions of emulsoid colloids as contrasted with suspensoid colloids and most molecularly dispersed substances. The effect of emulsoids, as a result of surface adsorption, is in general to diminish surface tension with consequent diminution in surface energy. LINDFORS[1] has recently called attention to the applicability of this criterion to sugar products. He states that cane and beet sugars may be differentiated by means of the surface tension values of their solutions, that of beet sugar being lower. The writers' investigation of a number of samples of cane and beet sugars indicates, however, that surface tension is not an infallible criterion, being merely an indication of the presence of minute quantities of hydrophile colloids which may occur in cane as well as in beet sugars. So far as differentiation of cane and beet sugars is concerned, the writers have found measurement of *pH* values to be generally more indicative than surface tension. The latter, however, is undoubtedly a valuable and exceedingly sensitive criterion of the presence of emulsoid colloids in minute amount in cane and beet products. Owing to the character of the σ-concentration curve (to be discussed later), the value of σ probably has only a limited application in determining the approximate proportion of emulsoids present.

Cataphoresis.—Because of its importance as a possible indication of colloid stability, a number of ultramicroscopic[2] measurements of the rate of electric transfer have been made. The application of this test is complicated by the presence of electrolytes, especially in after-products, such as molasses. Moreover, when applied ultramicroscopically, it presents the difficulty of securing definition in the case of emulsoid colloids. Ultramicroscopic cataphoresis data should, in general, be regarded as referring to colloids of more typically suspensoid than emulsoid character. Macroscopic observation may be preferable in some cases.

Table I.

ULTRAFILTRATION, GOLD NUMBER, AND SERVICE TENSION DATA.

Sample.	Weight Dry Substance Ultra-filtered, Grms	σ Dynes* Per cm.		Gold Number before Ultrafiltration, Mgrms.	Dried Colloids in Sample		Water-Reversible Fraction in Colloids, Per cent.	Water-Irrev'e Fraction in Coll's Per c
		Original Solution	Ultra-Filtrate		Grms	Per cent		
				Granulated sugar.				
1	1270	56·0	74·0	2600 to 2700	1·0202	0·080	94·9	5·1
2	1560	57·8	74·0	3120 ,, 3380	0·9168	0·059	75·6	24·4
3	2080	59·6	—	2931 ,, 3015	0·3962	0·019	43·0	57·0
4	5720	74·7	74·7	— —	0·9463	0·017	17·0	83·0
				Beet molasses.				
1	1250	52·8	—	884 to 988	4·9637	0·397	53·8	46·2
2	1249	52·7	—	832 ,, 936	5·5433	0·444	51·6	48·4
4	1249	49·3	—	798 ,, 840	2·5118	0·201	30·2	69·8

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[1] *Ind. Eng. Chem.*, 1924, 16, 813.

[2] A recent model Zsigmondy-Siedentopf slit ultramicroscope was used, the cataphoresis apparatus proper was designed by S. E. MATTSON, Bureau of Soils, to whom appreciative acknowledgement is made.

* Measurements of σ were made at constant solids concentration at 20° C by means of the du Noüy ring apparatus. (*La Nature*, 1920, [illegible], No. 2391, 63.) They represent static value in all cases

Gold number.—Several determinations of the gold number were made, the gold sol being prepared by the Anderson-Elliott[1] method. The test was applied essentially in the form proposed by Zsigmondy.[2] This value is a measure of effective colloidal protective action and is directly associated with emulsoid colloids, but its correlation with the other criteria is not fully apparent. Determination of the gold number suffers in precision in the case of cane and beet products (except sugar), owing to the dark colour of these products.

Surface Tension, Gold Number, and Ultrafiltration Data.

Table I gives data on surface tension, gold number, colloid content, and water-reversible and water-irreversible colloid fractions. The term "dried colloids" designates the dried water-washed material retained by the ultrafilter. The colloid permeability of the ultrafilters used was quite low and they were, for instance, capable of retaining such highly dispersed colloidal materials as dextrins and caramel. The concentration of the sugar solutions, as prepared for ultrafiltration, was 260 grms. per litre; and the samples of molasses were diluted to 25 per cent. solids. Particles too large to be regarded as colloidal were removed by a standardized filtration prior to ultrafiltration.

The samples of granulated sugar listed in *Table I* represent ordinary commercial grades. They progressively decreased in lustre of crystals in the order 4-3-2-1, Nos. 1 and 2 being particularly lustreless. It will be noted that the value of σ likewise progressively diminished in the order 4-3-2-1. The percentage of dried colloids and of the water-reversible fraction both progressively increased in the order 4-3-2-1. These relationships indicate that the water-reversible fraction (emulsoid type) is primarily responsible for the decrease in σ, and plays an important part in causing the lustreless, greyish appearance of the granulated sugar crystals. The writers attribute the greyish appearance to colloid contamination of the crystal faces, possibly by adsorption, during crystal growth. In case adsorption is the mechanism by which the crystals are contaminated, the emulsoids may exert a determining influence in causing the greyish, lustreless appearance either by direct adsorption *per se*, or through a protective action which permits the less highly solvated colloids to maintain an extensive surface area and to be adsorbed by the crystals.

The foregoing result demonstrates at once that the tools available for colloid investigation of this subject are sufficiently powerful to furnish constructive information. The subtances responsible for off-colour and lustreless sugar can now be separated and subjected to further investigation as to composition, origin, and means of elimination.

In most of the beet molasses samples there was little difference in the proportions of the two fractions, although in Sample 4 the water-irreversible fraction greatly predominated. These beet molasses samples were carefully selected to represent certain typical factory operating conditions, and it is believed that the variation in Sample 4 has distinct significance. Data on this point will be presented. In regard to the gold number, it will be seen from *Table I* that the gold numbers for granulated sugar and molasses are of the same order of magnitude for each product and are higher for sugar than for molasses. Since the values given indicate the weights of sugar and molasses solids required to prevent aggregation of the gold sol, the net colloid protective effect is greater for molasses than for sugar.

It is significant that in the case of the sugars, σ increased in the ultrafiltrate to practically the value characteristic of pure sucrose solutions. By ultrafiltering material, such as ordinary grades of granulated sugar, which contain minute proportions of highly dispersed emulsoids, and which also contain salts in such minimal quantities that the latter have no influence on σ, surface tension may be employed as an exceedingly sensitive criterion of the permeability of ultrafilters and their effectiveness in retaining colloids. If a mere trace of such colloid passes through the ultrafilter, the value of σ is appreciably diminished. A high degree of retention of the ultrafilters used in this laboratory is indicated by the fact that the σ value of ultrafiltrates from sugars which contained emulsoids of a degree of dispersion commensurate with that of dextrins was practically identical with the σ of pure sucrose solutions. Ultrafiltration is also an excellent procedure in connexion with the preparation of rigorously purified sucrose for laboratory investigation. Removal of colloid contamination is readily effected and even solutions of high density are brilliantly clear. In conducting the ultrafiltrations from which the data in *Table I* were derived, the water-reversible fraction invariably gave a negative α-naphthol test, thus indicating the effectiveness of washing in eliminating sugars from the ultrafiltration residue.

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[1] *Ind. Eng. Chem.*, 1921, 13, 699.

[2] *Z. anal. Chem.*, 1901, 40, 697.

REVERSIBLE AND IRREVERSIBLE COLLOIDS.

Table II contains data relating to the composition of the reversible and irreversible fractions indicated in *Table I*.

Table II.

PERCENTAGE COMPOSITION OF COLLOIDS

SAMPLE		Organic	Ash	SiO_2	CaO	Fe_2O_3 and Al_2O_3	COLLOID FRACTION
Raw Cane Sugar		97·69 ..	2·31 ..	0·55 ..	1·10	Trace ..	Reversible
Granulated Sugar	1	99·19 ..	0·81	Nil ..	0·43 ..	0·12 .	Reversible
		35·00 ..	65·00 ..	26·53 .	6·15 ..	24·42 ..	Irreversible
	2	96·22 ..	3·78 ..	0·52 ..	0·95 .	0·95	Reversible
		61·36 ..	38·64 ..	10·64 ..	1·79 .	11·80 ..	Irreversible
	4	97·84 ..	2·16 ..	0·58 ..	Nil ..	Trace ..	Reversible
		80·79 ..	19·21 ..	12·44 ..	0·52 ..	3·42 ..	Irreversible
Beet Molasses .. .	4	96·88 ..	3·12 ..	0·34 ..	0·63 ..	0·24 ..	Reversible
		86·83 ..	13·17 ..	3·37 ..	4·74 ..	3·67 ..	Irreversible

The data in *Table II* shows that the ash content of the irreversible portion is much greater than that of the reversible fraction. No separation of Fe_2O_3 and Al_2O_3 was made, but probably the latter was either absent, or present in extremely small proportion. The inorganic content consists primarily of compounds of silicon, calcium, and iron. Most of the SiO_2 is recovered in the irreversible fraction; that in the reversible portion may be truly water-reversible or, on the other hand, it may have been insufficiently dehydrated under the conditions of drying employed. (Compare in this connexion the customary analytical procedure for determination of SiO_2.) The Fe_2O_3-Al_2O_3 group is predominantly found in the irreversible fraction. This is to be anticipated since the colloidal iron compounds found in cane and beet products are disposed to lose their power of solvation when dried. The proportion of CaO found in the reversible fraction is, in general, relatively greater than SiO_2 and Fe_2O_3-Al_2O_3. In this connexion attention is directed to various statements in the literature regarding supposed colloidal calcium compounds[1] in both cane and beet products. Some of the observations relating to these compounds are strongly indicative of the presence of typical, highly solvated emulsoids of reversible character. It will be noted from *Table II* that the percentages of ash and of Fe_2O_3-Al_2O_3 in the irreversible fraction increase in the order 4-2-1 in the samples of granulated sugar, and very probably play an important part in producing the grayish, lustreless appearance.

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[1] For instance, the reference by Scheibler [*Berichte*, 1868, 1, 58] to the probable presence in beet products of calcium salt of a so-called metapectic acid Although sporadic references to the suject have been made since that date very little new information has been gained

It is possible that calcium, silicon, and iron are present in varying combination in the different samples, with resulting variation in the degree of solvation and reversibility. The extent to which these compounds may be present in the ultra-filtration residue as molecularly dispersible compounds adsorbed by colloids instead of being typical colloids *per se* is uncertain and requires further investigation. Furthermore, variation in the condition of drying may influence the reversibility of some of these compounds. When the reversible fraction is dried at 100° to 110° C., a portion of it becomes irreversible; when dried at 70°C. *in vacuo* (the customary procedure in this laboratory), the reversible fraction remains wholly reversible, although the degree of dispersion may conceivably be modified. The distribution of colloids between reversible and irreversible fractions is, therefore, to a certain extent dependent upon the conditions of drying, which should be standardized for comparative purposes. There is reason to believe, however, that the distribution between reversible and irreversible fractions is, for a large proportion of the total colloids, independent of conditions of drying within fairly wide limits.

The irreversible fraction very probably contains a considerable proportion of colloids which originally represented varying stages between the most typical emulsoid and suspensoid conditions, and which, as a result of flocculation (during ultrafiltration) and drying, have lost the property of becoming solvated. The writers have observed that these colloids do not reverse in sucrose solutions to an appreciably greater extent than in water. The total colloid viscosity effect must not, therefore, be ascribed to the water-reversible portion.

The appearance of the reversible and irreversible fractions was distinctly different. The reversible fraction of all the samples was yellow-brown to dark brown and remarkably homogeneous in appearance; when dried it assumed the form of lustrous scales similar in appearance to such tropical emulsoids as gum arabic when similarly treated. The irreversible fraction of the raw sugar colloids was dark brown, that of the granulated sugars dark grey, and that of the beet molasses light grey; this fraction, when dried, was of powdery consistency, in contrast with the typical scales of the reversible fraction.

As shown in *Table II*, the reversible fraction is predominantly organic in character. Its composition has so far been only partially investigated. The percentages of nitrogen in the reversible and irreversible fractions were, respectively, 0·07 and 0·20 for the raw cane sugar sample and 0·16 and 0·14 for Beet Molasses 2. The most suitable factor for calculating the percentage of nitrogenous compounds in this case is unknown, but it is evident that the proportion of such compounds in the colloidal material examined is extremely small.

(*To be Continued.*)

A new periodical of interest to the technologist generally has appeared under the name of *The Industrial Chemist*. The first number before us is particularly well edited, the arrangement of the matter, the printing, and the style of the advertisement displays being particularly good.

The Relation of the Beet Sugar Industry to American Prosperity.

The View of Mr. Truman G. Palmer.

In a recent number of the American *Manufacturers Record*, Mr. TRUMAN G. PALMER, the well-known U.S.A. sugar statistician and domestic sugar champion, gave his views on the value of the indigenous beet sugar industry to the prosperity of the United States, at the same time pressing for the retention of an adequate import duty against foreign cane sugar. Since his arguments are, *mutatis mutandis*, very applicable to the new beet sugar industry in England, we give some extracts from his contribution to the subject.

DIFFERENCE IN COST OF PRODUCTION.

"The difference in the cost of producing sugar in Cuba and the United States is so great that the home industry would perish if the duty were removed or even materially lowered. The main difference is in the cost of raw material and not in extracting the sugar. As disclosed by the investigation of the Tariff Commission in 1922, sugar in the cane cost the Cuban factories only $1.16 per 100 lbs., whereas the sugar in our domestic beets cost American beet sugar factories $3.37 per 100 lbs., our farmers receiving as much for their sugar as did the Cuban farmers, plus the import duty of $1.76, plus 45 cents per 100 lbs. In other words, our farmers received as much for 100 lbs. of sugar as Cuban farmers received for 290 lbs. of sugar. This is accounted for by the fact that in the beet sugar industry the farmers have to prepare a mellow seed bed each year and cultivate the beets intensively for several months, whereas in Cuba the planting of cane is almost the equivalent of planting an orchard, for once planted it continues to multiply for 20 to 50 years practically without cultivation. While making a study trip in Cuba several years ago, PRESIDENT MENOCAL informed me that the average cost of cultivating cane in the east end of the island did not amount to $1 an acre per year, and at Guantanamo I saw them taking off the fiftieth consecutive crop from the same roots without replanting. Thus the production goes forward indefinitely and almost without cost.

CHEAP SUGAR NOT TO BE DERIVED FROM CUBAN MONOPOLY.

"Considering the difference in cost of production, it might well be asked if it would not be better economic policy for the United States to give up the attempt to produce sugar at home and purchase all of it from Cuba. There are two good and sufficient reasons why this would not work to the advantage of the American people: it would not give us cheaper sugar, and we would lose the marvellous rotating value of the sugar beet.

"Cuba only furnishes us with cheap sugar when our domestic sugar is on the market in competition, or when the world price of sugar is low. It is beyond the pale of our anti-trust laws, and when occasion arises its producers form pools and combinations for the express purpose of making us pay more than a normal price for sugar.

"In 1920 when, except in Cuba, sugar was scarce and we were marketing the remnants of our domestic crop of refined sugar at 12 cents per lb., less 2 per cent., the sugar producers of Cuba, with warehouses full of sugar, met in Havana on June 30th and made an agreement or combination under the terms of which they agreed not to sell us a bag of raw sugar at less than 24 cents per lb. f.o.b. Cuba. That year they bled us for $669,000,000 for sugar, while our other foreign purchases of sugar amounted to enough more to make a total of over *one billion dollars* paid out for foreign sugar in that one year alone. In other words, we paid Cuban sugar exploiters an average of nearly two million dollars a day for the entire year for the purchase of a commodity we should have produced at home. If any group of domestic producers had tried to put over such a raw deal, all would have landed in jail, but producers in Cuba can do as they please and we have to grin and bear it. Again, in 1922, they put over a similar deal and cleaned up untold millions at the expense of the American people.

"A reduction in import duty will not give the people lower-priced sugar, but will give the American refiners and American owners of Cuban cane fields and sugar mills more profit. The American sugar industry will be the one to suffer, and after the domestic sugar industry has been crippled or put out of business, the Wall Street owners of the Cuban sugar industry will put up the price.

"The extra amount we paid for sugar in excess of a fair price amounted to more in a single twelvemonth than the entire cost to erect enough new factories to produce every lb. of sugar we consume, and produce it within the jurisdiction of all of our anti-trust laws, which insure us against the rapacity of monopolies. We cannot hope to get cheap or even reasonable sugar by giving Cuba a monopoly of our markets.

THE MAIN REASON WHY WE SHOULD PRODUCE OUR OWN SUGAR.

"A century ago Europe was overpopulated, every available acre was in cultivation, farm yields had been decreasing for centuries and starvation threatened. All has been changed through the introduction of sugar beet culture, which has so rejuvenated their worn-out soils that to-day they produce twice as many bushels per acre as do our own virgin fields. The increased harvest of succeeding crops induced by beet culture is greater than that secured by a heavy application of fertilizer. For three to five years after devoting a field to sugar beets it will yield 40 to 80 per cent. more bushels of wheat, rye, barley, oats, and other crops than it did before. The value of the extra yield of following crops exceeds the value of the beets themselves, and as the beets pay for themselves the excess yield of other crops costs the farmer nothing. If an EDISON or a BURBANK should invent a fertilizer which would give such results, it would command a fabulous price.

"For this and for another reason Europe gladly imports grains and exports sugar. Sugar takes no plant food from the soil. It is gathered wholly from the atmosphere, while wheat leaches from the soil its most valuable plant food. In their exports of wheat our farmers are shipping away vast quantities of plant food, and in the three to four hundred million dollars' worth of sugar we import every year we receive nothing but wind and rain and sunshine which sweeps over foreign fields. This process is costing our farmers untold millions of dollars through robbing the fields of their productivity, and millions of acres of our richest soils have become so depleted in plant food and so choked with foul growth that the crop does not pay for the cost of cultivation.

"No country in the world ever introduced beet culture with a view to producing sugar more cheaply than it can be grown in the tropics. All introduced it because of the indirect agricultural advantages. In order to expand their sugar industry, and thus have as many acres of sugar beets as possible with which to rotate their grain crops, the countries of Europe levied high sugar duties, created cartels, subventions and all sorts of encouragement, even paying their sugar manufacturers hundreds of millions of dollars in export bounties in order that they might be able to sell their sugar at a price below the cost of production and thereby capture the world's markets. During a series of years, Germany alone paid its sugar manufacturers $351,000,000 in export bounties. As a result of introducing beet culture, German fields now yield 30 bushels of wheat to our 15, 60 bushels of oats to our 30, 200 bushels of potatoes to our 100, and other crops in like proportion. By pursuing this course Germany in 30 years increased her annual yield of wheat, rye, barley and oats 539,000,000 bushels, the increase of each yearly harvest yielding her farmers more than all Germany ever paid out to stimulate the development of her sugar industry. During this 30-year export bounty-paying period Germany not only supplied her own people with sugar but exported it to the value of over one and one-half billion dollars. Reaping from the richest soils the smallest number of bushels per acre of any country in the world, we need this marvellous crop to rejuvenate our fields.

"We need the spread of sugar beet culture in order to relieve our distressed American wheat farmers, who are suffering not so much from low prices as from the fact that they secure a yield of only 12 to 15 bushels compared with a yield of 24½ bushels in north-western Europe. We need it in order to save our people from paying extortionate prices for a foreign product whose producers are not subject to our anti-trust laws. We need it in order to save the three hundred million to a billion dollars in gold which we annually send abroad for sugar."

Sugar Conditions in the British West Indies.

(Department of Overseas Trade Report.[1])

During the last twenty-five years the sugar industry of the British West Indies has experienced keen rivalry from beet sugar grown in European countries and from cane sugar grown in Cuba. Competition by beet sugar producers was rendered less severe as a result of an agreement made at the Brussels Convention in 1903 to curtail the bounties given to European beet sugar, but during the same year a reciprocal treaty was made between the United States and Cuba by means of which Cuba secured a preference of 20 per cent. of the duty on sugar imported into the United States from competitive countries. This concession was of immense benefit to the Cuban sugar industry, to which American capital was attracted for the erection of central factories, by means of which considerable economy in production was effected.

Since the great slump in values in 1921 the sugar industry of the British West Indies has passed through a trying period, assisted by such financial help as the Governments of the sugar-growing Colonies were in a position to afford. To make matters worse, many estates changed hands at much inflated values during the period of unparalleled prosperity, and at reduced values for sugar it was impossible to secure an adequate return on the capital invested. The position was aggravated further by the falling off in the demand for rum (a by-product of great importance to the sugar industry of Jamaica and British Guiana). Prohibition in the United States, the discontinuance of the demand from Germany, and the high import duties in the United Kingdom were the main causes of the decline in the rum industry. The demand for syrup also declined to a very large extent. Before the war the value of the exports from Barbados of molasses or syrup exceeded the value of the exports of sugar, and many factories in that Colony produced nothing else but molasses. During the last few years, however, the positions have been reversed.

An improvement in sugar values took place in 1922 and a further improvement in 1923. But about the middle of March this year prices fell to an alarming extent, and in

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[1] Report of H.M. Trade Commissioner (Mr. J L. W. GOODE) to November, 1924.

June they were approximately £11 per ton below the value before the decline set in. The value of grey refining sugar at the end of June was about £21 per ton c i.f. as compared with £32 10s. at the beginning of March. With prices thus reduced the outlook is one of uncertainty, more especially in view of the great reduction in the sugar preference in the United Kingdom.

In Jamaica and Antigua the sugar crops have been adversely affected by drought, but in Barbados and Trinidad crops have turned out better than was anticipated. The 1923 crop in Barbados was exceptionally good. During that year the quantity of sugar exported from the Colony was 49,060 tons, but the fancy molasses equated to sugar was equal to another 13,651 tons, making a total of 62,711 tons, valued at £1,820,571. According to the estimate of the Director of Agriculture, Barbados, the 1924 sugar crop, including fancy molasses equated to sugar, is likely to reach 60,000 tons. The tonnage of this year's crop in Trinidad is not yet known, but it is expected to be much larger than last year's crop of 41,619 tons. In British Guiana the estimates for the year 1923 were 95,494 tons of sugar from an area of 51,445 acres, but results showed production to be short of the estimates by 3038 tons, and the area under sugar cultivation by 1783 acres. The reduction in the acreage under sugar in British Guiana and in the yield in 1923 as compared with the previous year was 4088 acres and 8672 tons.

The decrease of acreage in British Guiana is attributable primarily to the shortage of labour consequent upon the cessation of East Indian emigration, but of recent years the sugar industry has also suffered by the diversion to the diamond fields of a number of the heavier class of labourers of African descent

The area under cultivation in sugar in the British West Indies varies according to the demand as compared with that of other tropical products. In Jamaica the cultivation of the sugar cane and the manufacture of its various products have been largely superseded by the cultivation of bananas. Quite recently, however, British capital has been attracted to Jamaica for agricultural development and has lent encouragement to an extension of the cane fields in that Colony. Last year a British company took over a sugar factory of 10,000 tons capacity which had ceased to operate, and an inducement was offered to plant more canes on the north side of the island where the factory is located In the eastern end of the island coconut trees and other plants are being destroyed so as to bring larger areas under cane cultivation. The Jamaica Sugar Estates, Ltd., have largely increased their capital and contemplate extensive developments

In Trinidad a much larger area is under cultivation in cocoa, but an increase in the cane farming industry of the Colony has taken place recently consequent upon the low prices obtainable for cocoa. An area under indifferent cocoa cultivation of about 1000 acres in situations favourable for the transportation to existing factories has been transferred from cocoa to sugar cane. And subject to these limitations there is a tendency for the transfer to continue.

As regards the Leeward Islands, the normal production of sugar in both the Presidencies of Antigua and St. Kitts is approximately 12,000 tons of grey crystals. A small amount of Muscovado sugar is manufactured for local consumption in Antigua, Nevis, the Virgin Islands and Montserrat. A small quantity of syrup is produced in Dominica and consumed locally either in the form of syrup or after conversion into rum. During the season 1922-23 a white sugar factory plant was installed at Gunthorpes Factory in Antigua, and during the year 1923 120 tons of plantation white crystals were manufactured there. During the 1924 crop this factory produced 200 tons of refined white crystals Since the decline in the lime industry of Dominica serious consideration has been given to a proposal to erect a central factory in that island for the manufacture of grey crystals.

Apart from special circumstances, conditions during the last two years have encouraged cane farmers to plant new areas, and it is expected that the 1925 crop will be a record one, and the 1926 crop even larger. Subsequent devolopments will be largely determined by the prices obtainable during the next two years.

Publications Received.

Cane Sugar and its Manufacture. H. C. Prinsen Geerligs, Ph.D. Second Revised Edition; xii + 342 pages, super-royal 8vo. (Norman Rodger, 2, St. Dunstan's Hill, London, E.C. 3.) 1924. Price; 20s. net. (Second Notice.[1])

A modest textbook on sugar manufacture appearing in the early nineties served to introduce Dr. GEERLIGS to English reading sugar technicians and this, when expanded in 1909, to the first edition of the work now under review, has for long, served as a standard authority on cane sugar manufacture. The present edition follows in general the same lines as the first. It differs therefrom in that results obtained by investigators in countries other than Java are included, whereas the first edition was almost wholly confined to Java practice.

As it stands at present, the first 108 pages are devoted to a concise yet full presentation of the chemistry of the constituents of the sugar cane.

The remainder of the book is devoted to sugar manufacture and herein this second edition is expanded to contain an account of what developments have taken place in the last fifteen years. Of particular interest are the pages devoted to boiling and curing, as it is at these stations that most improvement has taken place.

Dr. Geerligs' name is particularly connected with the theory of molasses formation presented in a classic memoir over thirty years ago. The later work of VAN LINDEN and HELDERMAN has resulted in some modification of Geerligs' theory as originally formulated and a full account of these later views is given.

This latest work of Dr. GEERLIGS can be confidently recommended as affording a scholarly presentation of the science of sugar manufacture.

NOEL DEERR.

Preservatives etc. in Food Regulations, 1925 [proposed to be made by the Minister of Health, England.] No. 69,755. (H. M. Stationery Office, Kingsway, London, W.C. 2). 1925. Price: 2d.

Among the Regulations specified are that: (*1*) No person shall manufacture for sale or sell any article of food which contains (*a*) any added preservative, except in the cases in and the proportions specified in Part I of the First Schedule; or (*b*) any of the colouring matters specified in Part II of the said Schedule. The First Schedule permits sulphur dioxide up to 7 grains per lb. in some foods (e.g., dried fruit), but only 0·3 grain in others (e g., jam); and benzoic acid up to 5 grains per pint in non-alcoholic drinks, mineral waters, and the like. Colouring matters which may not be added to foods comprise metallic compounds (e.g., of copper, arsenic, mercury, lead, zinc, etc.); vegetable colouring matter, namely, gamboge; and coal tar colours, as picric acid, Victoria Yellow, Manchester Yellow (Naphthol Yellow), Aurantia, Orange II, and Aurine. Any articles of food containing preservative shall bear a label on which is printed distinctly a declaration stating the name of the chemical, and (in the case of sulphur dioxide) its amount.

The Chemistry of Enzyme Actions. K. George Falk. Second and Revised Edition. (The Chemical Catalog Co., Inc., New York, U.S.A.) 1924.

Enzyme study is of importance, not only as a part of chemical science, but also in its biological aspects because of the bearing of such actions upon the changes occurring in life processes. In this monograph is summarized much of the recent development of the subject, though not all, as the author does not attempt to do this in the space at his disposal. It has been his aim rather to bring out the relationships of enzyme actions to other problems in chemistry, and to present some of the more recent work in order to show the trend the study is taking.

The Home Grown Industry: Its History and Development. Alfred Wood. (The British Sugar Beet Society, Ltd., 6, Lancaster Place, W.C.2.) 1925.

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[1] See also *I.S.J*, 1925, 50

Report of the Commission of Enquiry on the De Vecchis Beet Sugar Process. Presented to Parliament by Command; Cmd., 2343; 18 pages and 3 drawings. (H.M. Stationery Office, Kingsway, London, W.C. 2.) 1925. Price: 9d.

A Commission consisting of Mr. JOHN BOWDEN, M.I.C.E., Dr. WM. GOODWIN, and Dr. B. J. OWEN, was despatched by the Ministry of Agriculture to Italy to report on the De Vecchis process.[1] As a result of their enquiries, they state that "while the principles of the De Vecchis system are in our opinion technically sound, the whole question of their practical application is still open"; that "it is extremely difficult to say whether the claims made for the system would be realized in practice"; but that "the system is considered sufficiently promising to justify further experimental work on the lines suggested." This Commission recommends that a complete, small plant be set up in England to test the process experimentally. They estimate that, whereas the amount of water, per cent. of the roots, is 935 in the usual procedure (including washing, diffusion, condensation, washing the carbon dioxide, and raising steam in the boiler plant), this value in the case of the De Vecchis process is only 260 per cent. On the other hand, whereas at present the coal used is assumed to be 8 per cent., with the new system proposed it would be 12 per cent. (made up of drying, 8 per cent. and other requirements in the factory 4 per cent.). But we would remark that these points and others that arise in considering the practicability of such a process might preliminarily be examined before proceeding to erect a small-scale plant. Anyway, experiments with a small-scale plant will not finally establish the value (or otherwise) of DE VECCHIS' proposals, which by the way are certainly not new, as seems to be assumed.

Trade Notices.

From the MIRRLESS WATSON COMPANY LIMITED, of Glasgow, we have received several pamphlets relating to their sugar machinery and specialities. A "List of Parts for Cane Milling Plant" gives code words for ordering every important piece of machinery likely to be wanted for replacement in one of their plants. Most of the parts are not only described but also illustrated, thereby facilitating identification. Other printed matter relates to the Meinecke Patent Intermediate Carriers; to Multiple Effect Evaporators, wherein two schemes for correct regulation of the liquor level are offered, one being by means of combination overflow and ball float regulators, and the other an Overflow type. A convenient continuous Syrup Sampler is also offered. Copies of these pamphlets can be obtained on application to the firm in question.

Attention may be drawn to the VISLOK Patent Lock Nuts supplied by Vislok Limited, of Salisbury Square, London, E.C 4. This lock which consists of two parts (non-detachable) gives three locks by the simple method of rotating the upper half with a spanner while the lower half is held by another; this alters the thread pitch in the upper half causing the threads to act as a number of wedges. In addition, there are two other points of grip due to the method by which the upper half is wedged into the lower one. The result is a union between nut and bolt which is claimed to be immune from any tendency to slacken through vibration. Amongst the positions where such nuts may be of advantage in the sugar factory may be mentioned: King bolts for all spring-loaded crushers; mill wedge-adjusting bolts; mill trash-bar adjusting bolts; gearing pedestals; gear wheel segments; connecting rods and valve gear of all engines; all bolts on moving parts of centrifugals, mixers, conveyors and elevators; couplings between driving motors and cane knives, shredders, centrifugal pumps, etc.; field locomotives and track; automobiles and trucks; and the like. Vislok nuts are stocked in diameters from ½ in. to 4 in., but can be made of larger dimensions if required, 6 in. nuts for instance being quite feasible.

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[1] *I.S J.*, 1924, 337, 447.

Brevities.

Prof. **James C. Irvine**, D.Sc., Ph.D., F.R.S., Principal of St. Andrew's University, Scotland, whose work on carbohydrate chemistry is well-known,[1] was one of the recipients of a knighthood in the New Year Honours List.

E. C. C. Baly and **E. S. Semmens**[2] describe experiments claiming to show that plane-polarized light causes a powerful acceleration of the diastatic hydrolysis of starch from potatoes, wheat, or maize.

"Sugar-bloom" in chocolate is stated by **R. Whymper** and **A. Bradley** to be the result of condensation and adsorption of moisture by the sugar present and a subsequent drying-out. The tendency for this condition to develop is proportional to the fineness of the sugar particles, and is most pronounced in chocolates containing less than 34 per cent. of fat.

In regard to antiseptics for the preservation of juice previous to analysis in the laboratory, Dr. W. C. **Reynolds**[4] tabulates the germicidal qualities of a few substances according to the **Rideal-Walker** coefficient: Cinnamic acid, 30; thymol, 25; menthol, 19; and safrol, 11·0. Formalin, which is very often used for the purpose specified, possesses quite a low value compared with those substances mentioned.

Blue-print "progress charts" are being distributed by the promotors of the "Germ" process of improving the lubricating quality of oil.[5] These charts are stated to report the work of independent authorities of international repute, carried out during 1920-24, and references are given to the original articles published by these experts. These results demonstrate strikingly the advantages of this process of lowering the surface tension of the oil by the addition of different substances,[6] e.g., fatty acids.

In the first Annual Report[7] of the College of Agriculture, Mauritius, which was inaugurated in September, 1923, it is explained that funds for its maintenance are provided by means of an export tax on sugar of 3 cents of a rupee per 100 kg exported. Dr H. A. **Tempany**, (who is the Principal), lectures on Agriculture and Agricultural Geology; Mr. L. **Baissac** on Sugar Manufacture and Sugar-House Chemistry; Mr. D. **d'Emmerez de Charmoy** on Entomology; Mr E. F. S. **Shepherd** on Botany and Mycology; Mr. F. **Giraud** on Agricultural Chemistry; and Mr M. **Koenig** (who is Registrar) on Physics. The Advisory Board of the College consists of Dr. **Tempany** as Chairman, and gentlemen nominated by the Governor of the Colony, by the Chamber of Agriculture, and by the Société des Chimistes. Two-year courses of instruction are required for the Certificate of the College, and three-year for the Diploma; and the curriculum is specially drawn up to meet the requirements of young men destined for a career in the sugar industry.

Messrs. **Blair, Campbell & McLean, Ltd.**, the Glasgow firm of sugar and distillery machinery manufacturers, have just secured the services of Mr. P. H. **Parr** to take control of their sugar estimating and sales department. Mr. **Parr**, who is well known to our readers as a regular contributor on engineering subjects, and who is also the old "Arcanum" of the *Mechanical World*, has been connected with the sugar machinery industry for many years; he served his pupilage with Messrs. **Geo. Fletcher & Co., Ltd.**, of Derby, after which he was assistant chief draughtsman for some years with Messrs. **Fawcett, Preston & Co., Ltd.**, of Liverpool, and more recently he has been acting as leading estimater with the **Mirrlees Watson Co., Ltd.**, of Glasgow. Mr. **Parr** has also been connected with the locomotive department of the old **Midland Railway** Co. as technical draughtsman, while during the war his special knowledge of springs was utilized by an important Paris firm specializing in spring manufacture and working directly for the French Government.

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[1] For an abstract of one of his recent papers see *I.S.J.*, 1925, 597.

[2] *Proceedings of the Royal Society*, 1924, B97. 250-255

[3] *Journal of the Society of Chemical Industry*, 1925, 44, No. 9, 77-86T

[4] *The Industrial Chemist*, 1925, 1, No. 1, 46-47

[5] U.K. Patent, 130,377; *I.S.J.*, 1920, 478

[6] See also *I.S.J.*, 1920, 587

[7] *Colony of Mauritius: Report on the College of Agriculture for the year 1923*; *May 5th, 1924.*

Dr. ALFONS KUNZ, assistant during the past two years to Prof. GÉZA ZEMPLÉN of the chemistry department of the Technical University of Budapest, Hungary, has been appointed a Research Associate in the Polarimetric Section of the Bureau of Standards. Dr. KUNZ, who has published with ZEMPLÉN notable researches on amygdalin, will continue investigations in the sugar group as assistant to Dr. C. S. HUDSON, his stay in the U S.A., having been provided for by the International Education Board

"Subox," a new type of paint, is a colloidal suspension of lead in linseed oil, which forms on the treated material a very firmly adhering metallic film.[1] It is applied in two coats, the second of which leaves a brilliant surface, and these two coats are equivalent to a triple red-lead surface, in respect of covering capacity. This lead paint is claimed to have remarkable rust protective properties, and its adherence is such as to resist removal by means of sharp steel-wire brushes. It is the invention of a Swiss engineer.

DR. PRINSEN GEERLIGS[2] calls attention to the Schoop "metallizing" process of coating metals by spraying molten copper, aluminium, etc. upon their surface, already noticed in these columns.[3] A coating of any suitable thickness, consisting of one metal, or more than one, can be easily given to objects of different material and shape. He regards this process as an excellent one for application in sugar factories and distilleries for protecting such as troughs, heater bodies, pipes, subsiding tanks, and the like against attack by the action of acids or corrosion.

Among new companies recently registered in the United Kingdom is the following: BONNITE MEDICAL CARBON COMPANY, LTD , 141, Moorgate, E.C.—Private company. Manufacturers and dealers in carbons of all kinds, etc. Nominal capital £6000, in £1 shares. Dr. BERNARD DYER AND PARTNERS, LTD , 17, Great Tower Street, E C. 3.—Private company. Analytical and consulting chemists. Nominal capital, £5000 in 2000 preference and 3000 ordinary shares, all of £1 each. UNITED SUGAR CO., LTD.—Private company. Object:—To establish and work sugar factories or refineries and all subsidiary plant and apparatus in Great Britain or elsewhere. Nominal capital £300,000, in 290,000 ordinary shares of £1, and 200,000 deferred shares of 1s. each.

A writer in *The Grocer*,[4] a Mr. J. S. BROOKES, having in a tirade against West Indian sugars given the ordinary raw sugar process as the method of making Demerara sugar, is corrected by the *West India Committee Circular*,[5] in a leading article. The writer mentioned is directed to descriptions of the *modus operandi* as given in standard textbooks[6] and to an article by the late Mr. F I. SCARD,[7] an acknowledged authority, who stated that clarification must be so modified and extended, and so conducted as to preserve the canary colour of the juice, and operations must generally be directed so as to eliminate undesirable impurities which would interfere with the delicate flavour of the finished sugar. Then the writer in *The Grocer* is reminded that there are products which are quite wholesome although they are not of 99·9 per cent. purity as regards content of sucrose, e.g., table syrups, the non-sugar constituents of which are not dissimilar to those existing in West Indian Yellow Crystal sugars.

We regret to record the death on the 23rd Feb. of SIR EDWARD THORPE, F.R.S., the eminent chemist and physicist, in his 80th year, at Salcombe, South Devonshire. He had successively been Professor of Chemistry at the Royal College of Science, South Kensington; Principal of the Government Laboratories; Director of the Chemical Laboratories of the Imperial College of Science and Technology (and later Emeritus Professor on his retirement); President of the Chemical Section of the British Association; and President of the Society of Chemical Industry. His name will be known in his profession for many years to come as editor of the "Dictionary of Applied Chemistry," which stands alone among works of its kind in any language. These volumes (a new edition of which commenced to appear in 1921), known briefly to chemists as "Thorpe," alone form a splendid memorial of scholarship and work.

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[1] *Chemical and Metallurgical Engineering*, 1924, 31, No 20 (Nov 17th), 775.

[2] *Indische Mercuur*, 1924, 47, 558.

[3] *I.S.J.*, 1923, 543.

[4] January 31st, 1925.

[5] February 12th 1925.

[6] "The Manufacture of Cane Sugar," by JONES and SCARD, revised edition (Duckworth).

[7] *Louisiana Planter*, 1914, 404-409.

Review of Current Technical Literature.[1]

EXPERIENCES WITH THREE TYPES OF BAGASSE FURNACES. *J. O. Frazier.*[2] *Power, 1925, 60, No. 18, 682-683.*

According to the author's experience, the type of furnace shown as No. 1, an ordinary furnace modified to burn bagasse (water content, 50 per cent), proved the least efficient as a steam generator; No 2, a Dutch oven of typical proportions, was the best of the three (judged when it was burning coal as extra fuel); and No. 3, an elaboration of the previous oven, in theory considered best by reason of its having a combustion chamber quite remote from the boiler surface. With the shipment of boilers for No. 1 came recommendations from the makers that its combustion chamber be filled and paved over from the summit of the bridge wall to the top of the arch over the mud drum. This was not done, because it was suspected that there would be a spill-over the bridge wall, which would soon fill this space with more or less imperfectly burned bagasse. After about a week's run, the attendant of No. 1 complained that the newly installed boilers were taking less and less water every day, and after three weeks the capacity had fallen to about 30 per cent., but when the combustion chamber was cleaned, the original steaming capacity (never very high) was restored This result was fresh in mind when it came to the installation of No 2 Instead of using a blower, with hollow blast grate bars and 80 ft. of stack, a 125 ft stack was built for use with wide-spaced herringbone grate bars, making a furnace quickly convertible into a coal burner during stoppages of the mill But even with the strong draft available, it was not possible to burn enough coal in No. 2 to make much over half the steam which was being made with bagasse. The much better combustion in the ovens of Fig. 2 resulted in the ash being carried over the bridge wall to so slight an extent (with most of the lighter ash going up the chimney) that several seasons would have been required to fill these chambers. In spite of much greater furnace room and the larger and presumably superior combustion chambers, No 3 furnace has not shown itself superior to the more modest No. 2 furnace. The four boilers in the No. 2 battery showed different rates of steaming, which differences, so far as known, were due to differences in

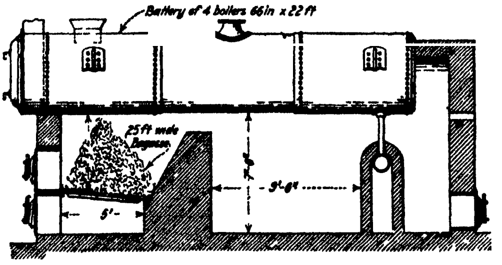

Fig. 1—Setting No. 1 (McCall, Pa., 1892)

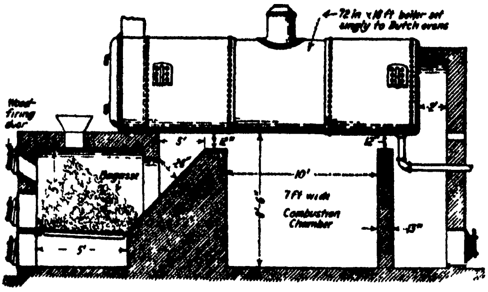

Fig. 2—Setting No. 2 (Schriever, La., 1897)

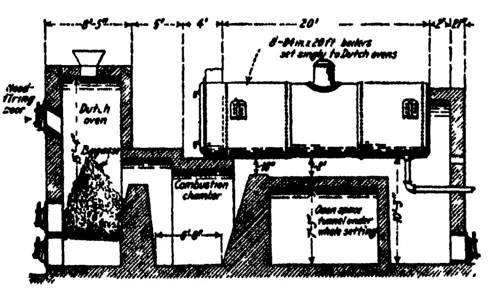
20'
4'
5'
6—84 in. x 20 ft boilers set singly to Dutch ovens
Wood-firing door
Dutch oven
Bagasse
Combustion chamber
Open space tunnel under whole setting

Fig. 3—Setting No. 3 (Ermita, Cuba, 1915)

freedom of gas outflow. It is probable that no arrangement of breeching division would work any improvement in equalization. Taking all in all, however, No. 2 came considerably nearer making sugar with bagasse alone than any other of its day. It is not yet equalled by more than 5 per cent. of the more modern, more elaborate, and much more expensive furnaces with which it has been compared. In making these furnace arches, each firebrick was dipped into a fireclay batter and tamped into position with a wooden mallet, making no thicker seams than the inequality of brick surface made necessary. The result of this painstaking care was that the furnaces operated seven seasons, each of about two months, before any cracking of brick occurred, even with the disturbing factor of the inset feed hopper castings. Besides gas mixing and promotion of improved combustion, the mixing chamber performs a secondary function of real though variable value. This is the reduction of gas stratification as applying to fire-tube boilers. For example, in either Figs. 1, 2 or 3, with restricted gas passage along the bottom of the boiler, a velocity of gas flow is produced that prevents the cooler gases obeying the gravity impulse to settle among the hotter mass and be exchanged for hotter gases. As a result the boiler bottom is immersed in a gas bath cooler than the mean temperature of the gas delivery at that point. Such tendency to stratification is always present under high-velocity gas flow, and the aggregate value of the lowered heat transmission rate may be very considerable. When the remedy for this loss produces another useful and even larger saving due to better combustion, the inducement for provision of the mixing or combustion chamber is emphasized. It is very probable that such provision would have been worth while with all fires under all boilers; also that No. 3 would be improved in efficiency by allowing the open space tunnel to form a secondary combining chamber behind the second wall. Incidentally, No. 1 installation has held its reputation for poor steaming, while No. 2 has sustained its good showing. Also, the excess-fuel consumption at the factory of No. 3 is considerably greater per unit of cane milled than at two or three of its Cuban neighbours using Dutch-oven furnaces or more antique type, substantial duplicates of those in Fig. 2.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] Sugar Engineer, New Orleans.

IMPROVEMENTS IN THE HELE-SHAW STREAM-LINE FILTER.[1] *J. H. Pickard.*[2] (*A*) *The Chemical Trade Journal, 1925, 76, No. 1965, 71.* (*B*) *Communicated by The Stream-Line Filter Co, Ltd., London, dated February 19th, 1925.*

(*A*) Perhaps the most important improvement effected since Dr. HELE-SHAW first exhibited his filter is that, instead of the filtering packs consisting of square papers, with holes punched through them at regular intervals (so that these holes form tubes through the packs), the packs now consist of narrow strips of paper punched with holes. These packs lend themselves very readily to the construction of filters of various types, particularly filter-presses and suction filters, and this shape of paper has been found more suitable for dealing with liquors containing large quantities of solids. There have also been improvements in connexion with the feed, outlet of filtrate, and the method of removing the cake after the operation is completed. Mr. PICKARD demonstrated an experimental rotary self-cleaning filter, which has been used successfully, in which eight packs of filter paper are mounted on a central hub, through which the filter is connected to a vacuum. The packs form the spokes of a wheel which is mounted on a hub; the wheel is rotated into a tank of liquor to be filtered at a pre-arranged speed, and the rotation is stopped from time to time so that the cake can be removed from the filtering packs by blowing with compressed air. The vacuum is shut off during the removal of the cake, and applied again when the cycle of operations re-commences. Mr. PICKARD then went on to show how the separation of pigments (which are very fine and difficult to wash) can be carried out in a more expeditious and straightforward manner by the stream-line filter than by washing them by decantation and separating in filter-presses. The original laboratory type of stream-line filter is now being replaced by a new type, which incorporates several improvements and which can be used largely as a quantitative instrument. The pack can be open to view during filtration, so that the operator can see that everything is proceeding normally, and a graduated spring-head enables the compression applied to the pack to be read off directly in pounds or kilograms, so that any conditions can be repeated exactly at the same time. Pressures can be applied varying from 0 to 240 lb., and Mr. Pickard demonstrated the ease with which the separated solids can be recovered, and the readiness with which the filter can be cleaned. As to the method of supplying the liquor to the filter, whereas previously a pump was placed centrally in the pack, there is now substituted a separate pressure vessel and montejus, through which the liquid is forced by compressed air from a bicycle pump.

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[1] *I.S.J.*, 1923, 546 and 628.

[2] Of The Stream-Line Filter Co., Ltd., London.

(*B*) It is stated that experiments have been carried out in the West Indies on the possibilities of applying this filter in sugar manufacture. A defecated cane juice was passed through the Stream-Line filter, and a clear, light yellow juice showing an increase of purity 7° above the raw mill juice is said to have been obtained. It appeared that the filter removed not only colloidal matter but certain colouring substances as well. It was also established in these tests that sugar was not intercepted by the filtering surface, as had been proved to be so in the London experiments with solutions of raw sugars,[1] in which the pack and filtration pressures were considerable. These West Indian results are said to have been confirmed in Hawaii. A type of filter which is considered to be an improvement on that previously employed in these juice tests has been sent out to cane producing countries, and the report on the results obtained with it will be expected with some interest.

NECTAR OF FLOWERS [ITS COMPOSITION COMPARED WITH THAT OF HONEY]. **Thos. Steel.** *Proceedings of the Linnean Society of New South Wales, 1924, xlix, Part 3, 324-328.*

Factors controlling the amount of nectar in flowers are,—(1) whether the plants are visited by nectar-feeding birds (when comparatively large supplies are available), or whether they are frequented by insects (when a smaller amount is adequate); (2) the extent to which the flowers have been rifled by birds or insects; and (3) the use by the plant itself of the secreted material. Determinations of the sucrose and "fruit sugar" (dextrose and levulose) present in the nectars of different Australian flowers gave figures of the same order as those found by Alex. S. Wilson,[2] viz, up to about 9 mgrms. of total sugars per flower, or about 6 per cent. of the weight of the flower itself. Nectar contains from 70 to 90 per cent of water (determined refractometrically), and honey an average of about 22 per cent. It is therefore evident that the bee concentrates this material, probably while it is in the sac, removing 48 to 89 per cent. of water in the process Then the composition of separated nectar was examined, working with *Doryanthes excelsa*, in the bulky panicle of which plant an abundance of nectar is secreted. The results obtained showed a remarkably close resemblance in composition to that of honey, when the figures were calculated to the same water content. Sucrose, however, was absent in this sample of nectar examined.

DETERMINATION OF LEVULOSE IN PRESENCE OF OTHER SUGARS, USING OST'S SOLUTION. **Louis Nyns.** *La Sucrerie Belge, 1924, 44, No. 7, 210 220.*

Levulose reduces Ost's solution (cupric bicarbonate reagent)[3] at 49°C. whereas dextrose, levulose, and other sugars which reduce Fehling's solution at higher temperatures do not; and acting on this principle (which appears to have been originated by Ph. Biourge[4]), the author has elaborated the following procedure: 50 c.c. of Ost's solution are heated in a water-bath to about 49°C, 20 c.c of the sugar solution (containing at most 65 mgrms. of levulose) are added, and the mixture heated in a closed Erlenmeyer flask for exactly 2½ hours at exactly 48·5–49·0°C., the amount of cuprous oxide precipitated at the end of this time being determined by a suitable method, preferably the so-called Bertrand process, of adding ferric sulphate solution, and titrating with standard permanganate. Following this a determination is made under similar conditions, except that heating is performed at or near boiling point, either in a boiling water-bath, or on a sand-bath, the difference between these two results giving the dextrose, so that one may report both the levulose and the dextrose in the case of products containing these sugars. If moreover, determinations are made before and after inversion, one may calculate the sucrose, dextrose and levulose originally present in the product under examination in what appears to be an accurate and convenient way. Results of experiments are quoted showing that at 49°C. Ost's solution gives "not the slightest trace" of Cu_2O in the case of the following sugars: dextrose, galactose, mannose, lactose, and sucrose, whilst arabinose gives less than 7 mgrms, and xylose less than 13 under the conditions stated Tables showing the mgrs. of levulose corresponding to increasing amounts of cuprous oxide from 5 to 65 mgrms. are also given in this paper.

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[1] *I.S.J*, 1923, 630. [2] *Chemical News*, 1878, 38, 93 [3] See *I.S.J.*, 1920, 107.

[4] See Ph. Biourge "La Cellule," tome XI, fascicule 2, 375-399; *Revue Agronomique*, Nos 11 and 12; the method has also been applied by Prof. F. A. Janssens of the Institut Carnoy, 22, Rue du Canal, Louvain

PECTIC SUBSTANCES, AND THEIR IMPORTANCE IN THE SUGAR INDUSTRY. **Felix Ehrlich.** *Die deutsche Zuckerindustrie, 1924, 49, No. 36, 1045-1050.*

Dr. EHRLICH has shown that the insoluble "urpectin" of the beetroot (and other plants) under the influence of boiling water undergoes transformation into a soluble hydro-pectin, which is not a simple substance, but consists of two others, differing from one another widely chemically and physically. They are levo-rotatory araban and a dextro-rotatory calcium-magnesium salt of pectic acid, these being separated by extraction with 70 per cent. alcohol. In this way, the first-named is dissolved, and is being found to amount to 25 to 30 per cent. of the hydro-pectin. He has also isolated from pectic substances, not only arabinose, galactose, and methyl alcohol, but also what he calls the principal stone in their structure, namely, a complex poly-galacturonic acid, which on decomposition yields *d*-galacturonic acid, an acid of the carbohydrate series which until now has not been observed to occur naturally. This acid in the form of its calcium salt is responsible for the gelatinizing power of pectin, and is intimately connected with the adhesive properties of pectinous extracts. All processes for making adhesives from the mark of beetroot, in which acid is used in the extraction, lead to a product of inferior tenaciousness, because the esters of the poly-galacturonic acid are thereby saponified, if, in fact, these and the araban are not destroyed.[1] A few remarks are made on the rôle of the pectins in beet sugar manufacture. Depending on the time and the temperature used, the hydro-pectin passes during the process of diffusion into the juice, but during defecation the lime exerts a hot saponifying effect on the pectic acid, whereupon by hydrolysis poly-galacturonic acid is formed. This is precipitated completely and quickly by the excess of lime, but the levo-rotatory araban is not thrown down, persisting in the juices and syrups, and finally accumulating in the molasses, where probably it is the cause of many an unexplained difference between the direct and the double polarization methods of determining the sucrose content.

EFFECT OF SOME INORGANIC SALTS ON THE POLARIZATION OF SUGAR SOLUTIONS. **Robert J. Brown.** *Industrial and Engineering Chemistry, 1925, 17, No. 1, 39-40.*

An abstract of this paper has already been published,[2] and from the fuller data now printed it appears that the value for K for the salts experimented with were: Sodium chloride, 0·00246; potassium sulphate, 0·00199; sodium sulphate, 0·00205; and disodium phosphate, 0·00305. Therefore in the case of a 15 per cent. solution containing about 5 per cent. of ash on the sugar, assuming all this ash to be sodium chloride and the K value to be 0·00265, then the polarization calculated by the formula of JACKSON and GILLIS will be: $P\ 15 - (0{\cdot}00265 \times 15 \times 0{\cdot}2) = 15 - 0{\cdot}008 = 14{\cdot}992$. This shows that the decrease in polarization would be less than 0·01 per cent. While it is impossible to say from these results that the effect of a salt on the polarization of sugar is proportional to amount of both salt and sugar present under all conditions of concentration, the writer has proved to his own satisfaction that this relation holds for the ranges in which he worked. It appears to be possible to determine the effect of salts at low concentrations of sugar and salt by determining the value of *K* at high concentrations, where the relative error is low. He has not yet found a neutral salt that will affect the polarization of sucrose to the extent of 0 01 degree when used in the amount of 5 per cent. or less on sugar, provided not more than a single normal weight of the dilute sugar solution made up to 100 c.c. is taken.

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[1] See German Patent, 384,772 for the preparation of an adhesive by a procedure in which such a faulty method is overcome.

[2] *I.S.J.*, 1924, 315.

CALCULATION OF THE MOST PROFITABLE POLARIZATION OF PHILIPPINE RAW SUGAR FOR THE NEW YORK MARKET

Herbert Walker. *Sugar News, 1924, 5, No 12, 714.*

Comparative yields of raw sugar from a given quantity of sucrose in the mixed juice vary inversely as the polarization of the sugar, in a ratio of very close to 1·5 per cent. per degree polarization. That is to say, where 100 tons of 96° sugar could be made, the following weights would result from the same juice at polarizations of 95, 96, 97 and 98 : 101 5, 100·00, 98·5, 97·0. The calculation of the most profitable sugar to manufacture resolves itself into a simple multiplication of the above weights by the prices per ton at the corresponding polarizations, and the subtraction of shipping expenses. According to the present New York sales basis, quotations are based on 96° sugar with the following penalties and premiums: a deduction of 0·13 cents gold per pound (equivalent to P$5·20 per short ton of 36 centavos per picul) for each degree polarization, or fraction thereof in proportion, below 96; a premium of 0·13 cents gold per pound for each degree, or fraction thereof in proportion, between 96 and 97 polarization, and a premium of 0·075 cents gold per pound (equivalent to P$3·00 per short ton of 21 centavos per picul) between 97 and 98 polarization. The following table shows expected returns from the same amount of sucrose in cane, manufactured into sugar at different polarizations, taking as a base, for simplicity of calculation, 100 short tons of 96° polarization sugar. Costs of bags, freight, insurance, etc., is assumed to be P$20 per ton, a few pesos difference in this cost has practically no bearing on the calculation. No allowance is made for the increased yield of molasses resulting from higher polarization, since the value of this molasses is about balanced by the extra load thrown on the boiling house in producing it.

Polar-ization.	Tons	Basis, 6 cent sugar		Basis, 7 cent sugar		Basis, 8 cent sugar	
		Price per ton P$.	Net returns. P$	Price per ton P$	Net returns P$	Price per ton P$.	Net returns P$.
95	101 5	234 80	21,812	274·80	25,862	314·80	29,922
96	100 0	240 00	22,000	280·00	20,000	320·00	30,000
97	98 5	245·20	22,182	285·20	26,122	325·20	30,062
98	97·0	248·20	22·135	288·20	26,011	328 20	29,895

Analysis of these figures indicates that when sugar is selling at 7 cents a pound or less, 97 polarization sugar (at the refinery) is the most profitable to the central, and that it pays to go a few tenths above 97 rather than fall below. At 8 cent sugar the difference is very slight, and at 9 cent sugar or higher it would pay to make 96 polarization or less unles the selling basis were changed.

REPORT OF THE NEW YORK SUGAR TRADE LABORATORY FOR THE YEAR ENDING DECEMBER 31ST, 1924.

F. W. Zerban. *New York Sugar Trade Laboratory, Inc., 80, South Street, New York, U.S.A.*

Dr. ZERBAN reports that the number of samples tested by the Laboratory in 1924 was 19,371, showing a substantial increase over the previous year. The total number of bags represented by these samples was 30,467,318, or an average of 1579 bags per sample, against 1650 in 1923, and 1647 in 1922. The average polarization of all samples tested was 96·02, passing the 96 mark for the first time in the history of the Laboratory. The variation in average monthly polarizations was 0·72, slightly higher than in 1923, but lower than in 1922. The percentage of samples testing between 96 and 97 was 55·35, higher than in any previous year, while that of samples between 95 and 96 was 28·66, the lowest on record. Sugars polarizing between 90 and 95 comprised 9·80 per cent. of all samples, indicating that deterioration was not excessive. Only 0 18 per cent. of all samples polarized below 90, which is a further reduction from the corresponding figure in 1923. It appears from these results that, from the standpoint of polariscopic test, the quality of the sugars was on the whole slightly better than in 1923.

DETERMINATION OF SUCROSE, DEXTROSE, LEVULOSE, ETC., BY FORMATION OF THEIR OSAZONES. *Edmund Knecht and Eva Hibbert. The Chemical Trade Journal, 1925, 76, No. 1964, 44.*

Some further details are now available in regard to this interesting new method of determining sugars[1] (which is especially adapted for examining the products of hydrolysis of the more complex carbohydrates): Dissolve 0·1-0·2 grms. of glucose in water and make up to 100 c c. To 10 c.c of this solution, 1 c.c. of a saturated solution of sodium tartrate and a solution of 0·25 grms. of phenylhydrazine in acetic acid are added; the mixture is heated for 10 mins on a briskly boiling water-bath; a known volume of titanous chloride (which must be in considerable excess) is added; and the solution boiled for 1-2 mins over a free flame, while a current of carbon dioxide is passed into the flask. The excess of titanous chloride is ascertained by titrating the hot solution, after the addition of excess of hydrochloric acid, with a solution of Crystal Scarlet standardized against the titanous chloride solution, a permanent red colour indicating the end of the reaction. About 20 mins. is required for a complete estimation. Working in this way, the following results were obtained on pure materials—Glucose, 99 71 per cent.; levulose, 99·8 per cent.; sucrose (inverted), 99·6 per cent; maltose, 100·3 per cent.; lactose, 99·89 per cent.; and glucosamine, 99 8 per cent.

CANE SYRUPS AND MOLASSES, THEIR COMPOSITION, PRODUCTION, AND CONSUMPTION. [ALSO COMMENTS ON THEIR VITAMIN CONTENT.] *Wm. L. Owen. Proceedings of the Association of American Dairy Food and Drug Officials' 28th Annual Convention, August, 1924.*

Dr. OWEN presents useful analytical data on the composition of American syrups and molasses, and gives an account of the efforts made some years ago to devise means for defining several grades of these products Production and consumption statistics are also summarized. Then Dr. OWEN makes the following interesting remarks, from which it will be seen he "strongly suspects" the presence of vitamins in syrups and molasses, a suspicion (also expressed by the late F. I. SCARD) which, in fact, has just been confirmed[2]: "That syrups and molasses are remarkably wholesome foods is quite generally known and almost universally conceded to be true, in this country at least. Too much of their advertised food value, however, has been attributed merely to their sugar content, and too little to the wholesomeness and to the general salutary effect upon the digestion. It is quite obvious that these products exercise a beneficial effect in human or animal nutrition, quite distinct from the energy equivalent of their carbohydrate content. While an investigation of their vitamines seems still to be lacking, their beneficial effects when included in the diet would lead one to strongly suspect their presence in these products. It is said that lumbermen in the Canadian woods consume large quantities of the lowest grades of cane molasses and find that it keeps them remarkably free from the digestive disorders so commonly associated with a concentrated and monotonous diet. It is reported that in some tropical countries the native children who during the summer months become very emaciated, for lack of proper foods, become fat and vigorous during the cane grinding season, when they subsist largely on the juice of the sugar cane."

J. P. O.

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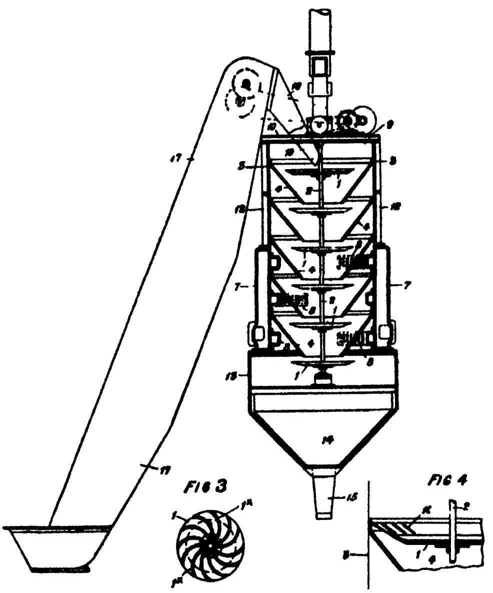
[1] *I.S.J.*, 1924, 669. [2] *I.S.J.*, 1925, 139.

Review of Recent Patents.[1]

DRYING SUGAR (AND LIKE GRANULAR MATERIAL) *Herbert W. Lowden*, of Manila, P.I., and *Archibald McArthur Lang*, of Liverpool (communicated to the last-named by *William Paterson*, of La Carlota, P.I.). *226,314.* June 25th, 1923.

Sugar (or like granular material) in the moist state with coagulated lumps is delivered upon a plurality of revolving discs, disposed vertically one under the other, these discs having ribs, undulations, corrugations, projections, or the like, on them, so that the lumps of sugar in passing over the irregular surface as the result of centrifugal force and then being thrown against a wall, will be broken up into separate grains During its flight from the discs a stream of hot air (a safe temperature is 125-150°F.) is caused to pass through the stream of grains, thus acting upon and drying them. Referring to the drawings, *1* are the centrifugal discs ; *2* their common carrier shaft revolved from above ; *3* is the general casing or shell of the machine, *4* are coned or tapered hoppers, which conduct the material from one stage or operation upon the central portion of the disc below : *7* are vertical trunks (say of cast-iron) into which the hot air is delivered ; and *8* are inwardly projecting conduits with vertical ports or openings on their inner faces, through which the hot air supplied through the trunks *7* is distributed at different levels into the lower part of the apparatus or machine ; these conduits at each section of the apparatus in the case shown, being carried round only a portion of the circle or cylinder at each side. On the top of the casing there are beams *9*, and a platform *10* supported by them, on which the machinery for driving the machine is carried ; and the load on this machinery platform is taken by columns *12*, which rest below on the top of the trunks *7*. The discs *1* are provided with an upper surface of irregular form, viz., with ribs, flutes or the like, in the case shown these irregularities being in the form of curved ribs 1^x bent or curved backwards more or less tangentially as regards the direction of rotation, from the centre portion of same to or near to the periphery ; and the edges of the discs *1* are slightly inclined or curved upwards, as shown, so that the material thrown off centrifgually, is given a whirling and upward direction. By this means the material being treated is prevented from accumulating in batches or uneven quantities locally on the discs (except the coagulated lumps). The whole is thrown onto the surface of the apparatus surrounding the discs or tables, with the result that the impact of the coagulated lumps on the surface disintegrates or breaks them up ; and this breaking up is also promoted by the formation of the disc surfaces in their movement from the centre of the periphery. Beneath the lowermost hopper *4*, the casing of the machine is of considerably larger diameter than the part above it ; and in the upper part of this enlarged chamber there is a disc *1* which finally operates upon the dry sugar in passing over its surface to its periphery, whence it is thrown outwards, and then falls down onto the hoppers-haped bottom *14* of the lower portion or chamber *13* and is carried away through bagging shoots or spouts *15*. In some cases in the last operation on the material, it is cooled by being acted upon by cool air,



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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

delivered from the lower conduits *8*, so that when it arrives in the chamber *13*, it is relatively cool; while above this point it is subjected to hot air only. This cooling air after acting upon the material, may, if desired, be then taken away from the apparatus and heated and dried in the heater, and then passed to the upper of the delivery conduits *8* in the hot state, the parts of the apparatus being suitably modified to carry out this latter method In some cases, there may be employed in connexion with the discs *1*, a grille of bars *16*, secured to the side of the apparatus all round, and extending down from same in a downwardly inclined direction, as shown, with their inner ends over the periphery of the discs *1*, the bars being suitably interspaced. Any lumps or masses, therefore, larger than the spaces between the bars, which are thrown off from the discs, will be caught by these bars, and conducted by them back on to the disc, so as to be reacted upon thereon, and broken or reduced in size. The material to be treated is elevated by the elevator *17* into a duplex hopper *18*, and is delivered by the spouts *19* in two streams onto the upper disc *1* (Patents Nos., 9261 of 1887, 13,364 of 1914, and 156,963 are referrred to).

MALTOSE AND AMYLOPECTIN DERIVATIVES FOR USE IN CONFECTIONERY, BREWING, ETC. ***A R Ling and D R. Nanji***, of The University, Birmingham. *224,269.* July 11th, 1923.

To produce a mixture of maltose and amylopectin derivatives for use in brewing, confectionery, etc., starch paste, which may be first liquefied by the action of malt, is treated with an extract of ungerminated grain (such as barley) and subsequently or simultaneously with an extract of germinated grain until it ceases to give a colour reaction with iodine. In some cases the treatment with extract of ungerminated grain is continued until upwards of 60 per cent. of the starch present has been saccharified and the treatment with extract of germinated grain omitted. Dry grists from germinated or ungerminated grain may be substituted for the extracts. For the extract of germinated grain may be substituted an extract of animal pancreas, or other animal or vegetable extract containing similar enzymes, which convert the amylopectin derivatives into isomaltose.

DRYING GRANULAR MATERIALS (*e.g.*, SUGAR). ***O. Randolph***, of Toledo, Ohio, U.S.A. *226,785.* November 10th, 1924.

Granular material to be dried is fed through shoots into a vertical casing through which it passes in a zig-zag path over heated duct units having end-walls, which form the side-walls of the casing when the units are assembled. Adjacent horizontal ducts communicate through openings in opposite end-walls with air and exhaust trunks, so that hot air induced through a pipe by a fan may pass into one of the exhaust trunks through alternate ducts into the casing, and through the remaining and higher ducts into the other exhaust trunk. From thence the air passes from the trunk into a cyclone separator having an air outlet and a duct tube leading to the discharge trunk of the dryer.

ACTIVE (DECOLORIZING) CARBON PRODUCTION. ***H. E. Potts***, of Liverpool (communicated by the ***Naamlooze Vennootschap Algemeene Norit Maatschappij***, of 2, den Texstraat, Amsterdam, Holland). *225,891.* June 8th, 1923.

Active carbon (for the treatment of oils, fats, and fatty acids), is treated, for example by spraying, with a limited quantity of an acid or acid solution or with gaseous acids, so as to yield a product containing all the natural ash. Suitable acids are hydrochloric, sulphuric, nitric, acetic, phosphoric, and tartaric acids, or alternatively gases, such as chlorine or sulphur dioxide, which yield acids in the carbon, may be employed. The carbon may be heated and agitated with the acid liquid under reduced, normal, or increased pressure. It is preferred to treat a gas activated carbon with a gaseous acid such as hydrochloric acid gas, and procedure for applying the carbon to the substances mentioned is described. The Provisional Specification describes also the treatment of other liquids, such as mineral oils, waxes, and solutions of glucose, lactose, etc., with acid active carbon and refers to obtaining the carbon by treatment with excess of acid, and to the treatment of mineral oils with a mixture of active carbon and strong sulphuric acid.

Patents.

Preventing and Removing Incrustations in Boilers, Evaporators, Pans, Heaters, etc ***E. A. Heberlein***, of London (*A*) 223,614. April 18th, 1923. (*B*) 223,847. April 18th, 1923.

(*A*) A small electro-motive force is applied directly to the shell of the boiler, or other vessel to be protected, and the current produced is varied by periodically interrupting and closing the circuit or a branch thereof. The circuit may be periodically interrupted by the oscillations of a blade, membrane or reed, attached to the boiler, etc., or to one of its accessories. (*B*) Boilers and the like are protected against scale deposits by applying a small E.M F. directly to the metallic shell thereof and superimposing upon the very small current produced a periodically varying induced current.

Production of Lactic Acid from Sugar Solutions by Fermentation. ***A. Pollak***, of Vienna, Austria. *222,514* September 29th, 1924; convention date, September 29th, 1923

In the production of lactic acid by fermentation of a sugar solution, the acid solution formed is withdrawn either continuously or intermittently and fresh sugar solution is introduced to replace it. The process may take place in a series of vats which are traversed by the solution at a controlled speed.

Production of Alcohol, Acetone, and Acetic Acid from Cellulosic Materials (possibly Bagasse) ***R. H. Norbury, A. P. H. Desborough, A. C. Thaysen, and L. D. Galloway***, of the Royal Cordite Factory, Holton Heath, Dorset. *222,549*, June 27th, 1923

Ethyl alcohol, acetone, and organic acids, such as acetic acid, are prepared by fermentation with *Bacillus acetoethylicus* of worts obtained by heating straw or grass under pressure with dilute mineral acids The wort during fermentation is maintained slightly alkaline by frequent additions of an alkali, such as lime. Alcohol and acetone are separated from the fermented mash by distillation and organic acids remain in the solution as salts A mixture of carbon dioxide and hydrogen is evolved during the fermentation.

Clarifying Centrifugal Machine ***Lilleshall Co., Ltd., and C A. Bishop***, of Oakengates, Shropshire *222,676* October 9th, 1923.

The rotary scraper of a separator is brought by an axial movement into position to scrape the filter, the scraper being of spiral form and carried by a rotor on a shaft. The strainer is of conical form, and may have longitudinal grooves, it is carried by a sleeve loose on the shaft On entering, the material passes through the distributing channels and is thrown against the filter-cloth. The liquid passes through the filter, and a spiral scrapes the filter-cloth when a handle is rotated. The scraper and filter run at different speeds, so that the scraper conveys the solids downwards; or the relative motion between the filter and scraper may be discontinued at will to provide increased time for filtration.

Production of Alcohol by Fermentation of Amylaceous Worts or Mashes. ***A. R. Ling and D. R. Nanji***, of The University, Birmingham *221,592*. June 28th, 1824.

The yield of alcohol obtained by the fermentation of amylaceous mashes or worts prepared with malt is increased by carrying out the preparation or the fermentation of the mash or wort in presence of enzymes which will hydrolyse the normally unfermentable β-dextrins and sugars, or of organisms which secrete such enzymes. Suitable enzymes are emulsin and the enzymes secreted by organisms of the orders *Aspergillaceæ* and *Penicillium*. The enzymes or organisms may be added with air-dried or green malt in the mashing-process or to the unboiled wort in the fermenting vessel.

Maceration Distributor for Cane Mills.[1] ***William G. Hall***, of 6th Avenue, Honolulu, T.H. *226,452*. July 17th, 1924.

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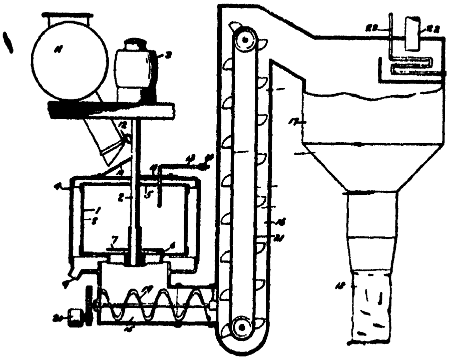
[1] U S Patent, 1,461,272; *I.S.J.*, 1923, 557.

UNITED STATES.

PURGING SUGAR IN A CENTRIFUGAL MACHINE IN A SUBSTANTIALLY STERILE ATMOSPHERE.

Bruno C. Lechler (assignor to ***Fletcher Works, Inc.***, of Philadelphia, Pa., U.S.A.). *1,511,619.* October 14th, 1924

Broadly, the invention relates to a process for purging sugar which consists in subjecting the sugar magma to centrifugal force in a substantially sterile atmosphere, the sugar thereafter being transported in a substantially uncontaminated atmosphere to a storage bin. Referring to the drawing, *1* designates a centrifugal basket driven from a drive shaft *2* by a suitable motor *3*, the centrifugal being surrounded by a casing *4*. The centrifugal or centrifugal basket is provided at its top with an opening *5* through which the massecuite is charged to the basket, and an opening *6* in the bottom thereof through which the sugar is discharged from the basket, this opening being controlled by a cover *7*. The sides of the basket are perforated as indicated at *8* to allow the discharge of molasses from the basket between the basket and the casing *4*, this molasses being discharged from the apparatus at the discharge spout *9*. The casing *4* is provided with a sectional cover *10*, and material is charged into the basket from a supply tank *11*, the discharge of material from this basket being controlled by a valve *12*. Steam is admitted to the centrifugal by means of a steam pipe *13*, the supply of steam to the centrifugal being controlled by a valve *14*. The lower part of the casing *4* is connected with a closed passageway *15*, in the present instance directly beneath the discharge opening *6* of the centrifugal basket, this passageway in operation being in communication with a closed passageway *16*, the latter leading to a storage room or bin *17* from which the sugar is conveniently discharged into bags *18*. The closed passageway *15* is provided with a conveyor *19* driven by a motor *20*, this conveyor being provided for the purpose of transporting sugar to the closed passageway *16* within which is an elevator *21* driven from any suitable source of power, adapted to receive the sugar from the conveyor *19* and elevate it to the storage bin *17*. The storage bin is provided with a pipe *22* which may be located adjacent the top of the centrifugal room or connected to the outside atmosphere. The purpose of providing the pipe *22* is to insure that a supply of uncontaminated air will be drawn into the centrifugal instead of taking the air from that portion of the room in proximity to the centrifugal as is usually done with apparatus now employed. If desired, steam pipes *23* may be provided near the pipe *22* so that the air drawn into the apparatus may be heated. It is to be understood that the passageways *15* and *16* are closed and that all air drawn into the centrifugal must pass through these closed passageways and likewise that sugar passing from the centrifugal to the storage bin *17* must travel through these closed passageways also. It may at times be feasible to discharge the sugar directly from the bottom of the casing *4* to some other point where the air is substantially uncontaminated and from which the air passes back through the centrifugal against the outgoing stream of sugar.



In operation the sections of the cover *10* of the casing are raised and the centrifugal basket *1* is charged with the sugar magma from the storage tank *11* and the covers closed. The centrifugal is then brought to speed whereupon the molasses is thrown out through the perforations *8* in the side walls of the centrifugal basket, caught in the outer casing and carried off through the spout *9*. While the centrifugal is still in operation, a jet of dry steam is passed into the centrifugal through the steam pipe *13*, this jet serving both to sterilize and heat the sugar and to cause the film of molasses adhering to each crystal to become more fluid and pass off more easily. After a sufficient period of time, the valve

14 in the steam pipe *13* is closed, thus shutting off the supply of steam to the centrifugal, the centrifugal basket however continuing to rotate and drawing in through the outlet *6* of the basket quantities of uncontaminated or sterile air from the upper part of the bin *17* through the closed passageways *16* and *15*. This air which may be slightly heated if desired, being drawn through the sugar in the centrifugal basket will serve to carry away the moisture in the basket remaining from the condensed steam and leave the crystals in as dry a condition as possible. The centrifugal is then stopped, the covers *10* opened, the cover or valve *7* at the bottom lifted, and the sugar discharged through the opening *6* in the closed passageway *15* upon the conveyor. The centrifugal may then be charged again; and, while in operation, the sugar in the passageway *15* will be agitated by the conveyor *19* and gradually conveyed to the closed passageway *16* where it will be lifted by the elevator *21* and carried up and discharged into the bin *17*, the sugar in passing from the centrifugal to the bin being subjected to the sterile air passing from the pipe *22* to the centrifugal. Finally the sugar is bagged from the bin *17* directly, without further contact with spore-laden air

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ROTARY CANE CUTTING KNIFE FOR MILLING INSTALLATIONS *Ernest M. Porter*, of Honolulu, T.H , U.S.A *1,512 484*. October 21st, 1924

One of the objects of the invention is the provision of knives having cutting blades on opposite sides of the shaft, each blade rotating in a different plane, whereby the cane may be cut into the shortest possible lengths and not crushed under the knives, such cutting resulting in a greater extraction of the cane juice at the first set of crushing rolls, and a better total extraction. Now referring specifically to the drawings (Figs. 1, 2 and 3 are prospective, plan, and front plan views of the invention; whilst Fig 4 is a section through line *4*—*4* of Fig. 3), *1* indicates a shaft which, as will be understood, extends transversely of the cane conveyor, not shown. The knife carrying portions of the shaft may be square, hexagonal, octagonal, etc , so long as squared surfaces are oppositely provided thereon, being here shown as hexagonal The ends of the shaft may pass through the side plates *2*, of the cane conveyor, and be provided with a driving pulley, gear, coupling or other means whereby power may be applied to the shaft and rotary motion imparted thereto. The knives, as a whole, are indicated by *A*, each knife being composed of blades *3* and *4*, and since the blades are identical, a description of one will suffice. The blades are preferably composed of manganese steel castings, subsequently subjected to heat treatment, whereby to increase the resistance of the blades to tensile strains. Each blade, in the casting operation, is formed with a hub section *5* on one side, and a thicker hub section *6* on the opposite side, as clearly shown in Fig. 1. More specifically, during the casting operation, one half of a hexagon, in the form here shown, is formed integral with the blade, the sections of the hub projecting laterally on each side of and from the body of the blade. It will be noted from an inspection of Figs. 1 and 3, that the portion *6* of

Fig. 1.

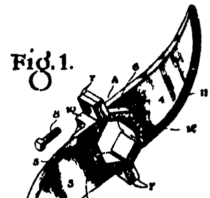


Fig. 3.

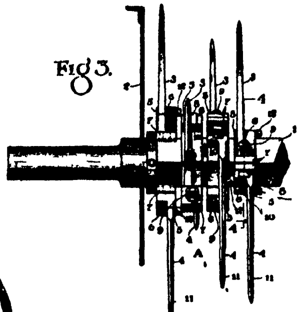


Fig. 2.

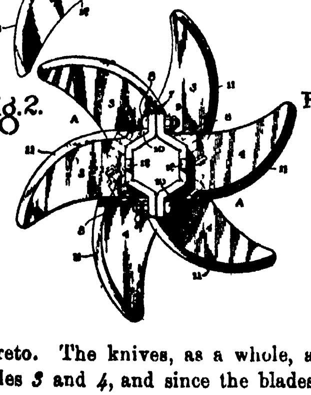
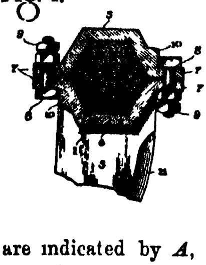


Fig. 4.



the hub section, on the right-hand side of the blade, projects further than does the portion *5*, on the other side of the blade, the blade, therefore, being laterally offset with respect to the transverse axis of the hub section. Each blade is provided with integrally formed vertically extending flanges *7*, provided with cored holes adapted, when the blades are brought into knife forming position on the shaft, to receive screw-threaded, headed bolts *8*, said bolts being secured to position by means of suitable lock nuts *9*, of approved design, each hub section *6* carrying a base *10*, positioned for contact by the heads of the bolts *8*, whereby to retain the bolts in position. The blades *3* and *4* are assembled around the shaft *1*, provided with properly squared portions, and positioned as shown in Fig. 1, the bolts *8* passed through the cored holes in the flanges *7* and secured in position, whereby the hub sections are clamped firmly around the squared portion of the shaft It will be noted that, because of the difference in lateral extent of the portion *6*, of the hub sections of the blade *4*, with respect to the portion *5*, of the blade *3*, the outer vertical surfaces of said portions lie in the same plane, but that the bodies of the blades are laterally and oppositely offset from the transverse axis of the hub sections. This construction results in a rotation of the blades *3* and *4* in laterally separated vertical planes, when the blades are positioned upon the shaft, as will be understood. The blades *3* and *4* are, of course, provided with sharpened cutting edges *11*, which are preferably curved backwardly, as shown in Fig. 1. Since the blades are identical for any installation, they may be used interchangeably. When the blades are assembled upon the shaft *1*, as shown in Fig. 3, the thick portion *6* of one hub section, may rest directly against the relatively thin portion *5* of the hub section of the next adjacent blade, whereby said portions serve to effect the necessary spacing of the blades, as will be understood. In the operation of this device, as explained, the blades are secured, as described, upon the opposite flat faces of the operating shaft. If the shaft is squared, there will be two double-bladed knives; if hexagonal, there will be three double-bladed knives, etc., each blade of each knife operating in a plane laterally separated from the plane of rotation of any other blade of the installation. In case of rupture of any blade, it may obviously be easily removed without disturbing any other knife of the installation.

IMPROVED ANIMAL CHARCOAL (BONEBLACK) HAVING AN INCREASED CARBON CONTENT. *Philip L. Wooster*, deceased, *Lillian D. Wooster*, administrix. *1,518,289*. December 9th, 1924

While the total area of the carbon surface exposed is relatively large in bone char as compared with many other decolorizing agents within the class available for commercial use, there is, nevertheless, a considerable portion of the surface of the pores of commercial char that is composed of non-carbonaceous material, and practically all of the surface is composed of a combination of carbon or carbonaceous matter with non-carbonaceous matter, partly in a state of mixture and partly in a state of chemical union. This process affects among others the objects of de-greasing the bone and carbonizing it, and also affects the elimination of a large proportion of the lime and lime compounds and other non-carbonaceous constituents It also increases the carbon content of a given volume of bone. When starting the manufacture of this product from green bone, the bone is boiled and heated in the usual manner and placed while still hot in a closed receptacle. In addition to the bone, however, one places in the receptacle at the same time a quantity of hydrocarbon, for example, bitumen. Under these conditions the heat from the char causes an incomplete combustion of the hydrocarbon, and the gases therefrom permeate the pores of the heated char carrying with them minute particles of carbon which are deposited on the surfaces and walls of the pores, thus largely increasing the carbon content. The product may at this stage be conveniently reduced to granular form by grinding or otherwise. The next step comprises treating the char with a reagent (e.g., hydrochloric acid) having such an action on certain of the inorganic constituents whereby they may be washed out with water or other suitable solvent or detergent. Following this, matter removed by the last mentioned step is replaced with carbonaceous matter from an external source. This may be accomplished by mixing the product resulting from the first step with carbonaceous material such as bitumen or other hydrocarbon or animal or vegetable oils, and heating the mixture in a retort or closed vessel. The result of the heating is that the vapours thereby created permeate the char, and the finely divided carbon particles are deposited in the minute openings of its structure, thus taking the place of the constituents which were eliminated by the boiling and washing process. This impregnating step can perhaps be carried out more advantageously by heating the hydrocarbon in a separate retort and allowing the vapours resulting from distillation to be conducted to or passed through the granulated char contained in a separate vessel. In either case the vapours are allowed to pass through or are drawn through the char until it is thoroughly permeated and the surfaces of the pores covered with a coating of minute particles of carbon. In addition to the increased efficacy of bone and bone char thus treated arising out of the increased carbon content, it is found that the resultant product becomes a stabilized structure and does not break down through rehandling.

WASHING RAW SUGAR CRYSTALS. *Pascual Hernandez*, of Camaguey, Cuba. *1,515,481.* November 11th, 1924. (Five figures ; two claims.)

This invention relates to an improvement in devices for purifying raw sugar by mixing the raw sugar with a liquid (sugar or molasses) capable of dissolving some of the impurities therefrom, and thereafter separating the liquid and impurities from the sugar and discharging the liquid and the sugar separately. The apparatus consists essentially of a perforated rotary cylinder contained within a stationary casing, said perforated cylinder also being provided with a feed screw by which the solid material is forced along from the inlet end to the discharge end, the inlet end being provided with inlets for sugar and purifying liquid, and also being provided with a mixing device by which the sugar and the liquid are thoroughly mixed and conveyed into the rotary perforated cylinder. The device also contains means for applying power to the several elements ; for rotating the perforated cylinder ; for rotating the feed screw therein, at a different speed of rotation ; and for discharging the washed sugar and molasses separately.

FACILITATING THE REMOVAL OF THE DEPOSIT FROM FILTER LEAVES (E.G. OF THE KELLY PRESSURE TYPE). *Charles L. McCarty* (assignor to *Wm. H. Horner and Robert W. Sikking*, both of East St. Louis, Illinois, U S.A.) *1,506,019.* August 26th, 1924. (Ten figures ; six claims)

Principal objects of the invention are : to minimize the time and expense incidental to the removal of the deposit from the filter, and avoid injuring the fabric or material of the filter leaves or plates ; to produce a novel and efficient mechanical contrivance which may be applied to the filter apparatus or machine as an attachment or component part thereof to automatically remove the deposit and deliver the same in a uniform condition.

Claim 2 reads as follows :—In combination with a filter including a tank and vertically disposed, spaced, parallel filter-leaves withdrawable endwise from said tank, and means for mechanically and automatically removing the deposit on said filter-elements as the latter are withdrawn, the same including a cable secured at its ends in a vertical plane between a pair of adjacent filter elements and at points above and below the horizontal planes of the tops and bottoms, respectively, of said filter elements, and being normally slack, a chain behind said cable in the same vertical plane, and a stripper following said chain

ACTIVE (DECOLORISING) CARBON PRODUCTION. (*A*) *R. E. Wilson and J. C. Whetzel. 1,519,470.* December 16th, 1924. (*B*) *Yoshiho Inada. 1,521,541.* December 30th, 1924.

(*A*) Metals or metallic oxides (1-10 per cent) are deposited on activated carbon by any suitable means, the activity of the material being in this way greatly increased (*B*) Decolorizing carbon is produced by heating Japanese coniferous wood containing a fragrant volatile resin, impregnating the residue with potassium acetate solution, and finally removing this salt

Sugar Crops of the World.

(Willett & Gray's Estimates to February 19th, 1925)

	Harvesting Period.	1924-25. Tons.	1923-24 Tons.	1922-23. Tons
United States—Louisiana	Oct.-Jan.	93,953	144,664	263,478
Texas	,, ,,	450	2,500	2,875
Porto Rico	Jan.-June	464,000	399,975	338,456
Hawaiian Islands	Nov.-July	590,000	626,279	479,463
West Indies—Virgin Islands	Jan.-June	2,500	2,332	1,739
Cuba	Dec.-June	4,724,714	4,066,642	3,602,910
British West Indies—Trinidad	Jan -June	50,000	52,045	41,619
Barbados	,, ,,	53,000	44,109	52,715
Jamaica	,, ,,	42,600	33,431	33,029
Antigua	Feb.-July	13,000	7,860	12,642
St. Kitts	Feb.-Aug	13,000	10,196	10,735
Other British West Indies	Jan.-June	9,000	4,488	5,292
French West Indies—Martinique	Jan.-July	23,000	17,000	19,700
Guadeloupe	,, ,,	34,000	27,548	25,043
San Domingo	Jan.-June	240,000	229,373	184,171
Haiti	Dec.-June	7,000	5,800	10,967
Mexico	,, ,,	165,000	166,932	119,457
Central America—Guatemala	Jan -June	24,000	20,850	24,445
Other Central America	,, ,,	65,000	56,000	50,336
South America—				
Demerara	Oct.-Dec. and May-June	100,000	95,494	101,128
Surinam	Oct. Jan.	10,200	10,682	11,719
Venezuela	Oct -June	19,000	17,488	16,840
Ecuador	Oct.-Feb.	18,700	13,662	14,220
Peru	Jan.-Dec.	300,000	326,352	313,743
Argentina	May-Nov.	240,000	249,162	209,718
Brazil	Oct.-Feb.	500,000	425,000	595,723
Total in America		7,802,117	7,055,864	6,542,163
Asia—British India	Dec.-May	2,486,000	3,266,000	3,044,000
Java	May-Nov.	1,978,000	1,771,772	1,746,875
Formosa and Japan	Nov.-June	460,000	448,736	405,800
Philippine Islands	,, ,,	462,000	372,332	263,437
Total in Asia		5,386,000	5,858,840	5,460,112
Australia	June-Nov.	417,500	281,859	306,678
Fiji Islands	,, ,,	70,000	58,000	37,154
Total in Australia and Polynesia		487,500	339,859	343,832
Africa—Egypt	Jan.-June	110,000	88,382	94,554
Mauritius	Aug -Jan.	238,000	201,550	231,190
Réunion	,, ,,	43,500	44,132	42,872
Natal	May-Oct.	165,000	181,571	142,287
Mozambique	,, ,,	70,000	60,000	45,950
Total in Africa		626,500	575,635	556,853
Europe—Spain	Dec.-June	10,629	7,871	13,918
Total cane sugar crops		14,312,746	13,838,069	12,916,878
Europe—Beet sugar crops		7,175,000	5,057,761	4,574,325
United States—Beet sugar crop	July-Jan.	925,000	787,217	615,936
Canada—Beet sugar crop	Oct.-Dec.	33,400	16,500	12,400
Total beet sugar crops		8,133,400	5,861,478	5,202,661
Grand total Cane and Beet Sugar	Tons	22,446,146	19,699,547	18,119,539
Estimated increase in the world's production	,,	2,746,599	1,580,008	504,484

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1925. Tons.	1924. Tons.
Total Receipts, January 1st to February 26th	492,446	503,173
Deliveries ,, ,,	480,974	503,967
Meltings by Refiners ,, ,,	414,150	420,130
Exports of Refined ,, ,,	3,100	5,000
Importers' Stocks, February 26th	11,472	—
Total Stocks, February 26th	105,873	107,496
	1924.	1923.
Total Consumption for twelve months	4,854,479	4,780,684

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1922-1923 1923-1924, AND 1924-1925.

(Tons of 2,240 lbs.)	1922-23 Tons	1923-24 Tons	1924-25 Tons
Exports	387,680	367,227	436,437
Stocks	274,135	240,662	293,891
	661,815	607,849	730,328
Local Consumption	5,000	5,000	6,000
Receipts at Port to January 31st	666,815	612,849	736,328

Havana, January 31st, 1925.

J. GUMA.—L. MEJER.

Beet Crops of Europe.

(Willett & Gray's Estimates to February 19th, 1925.)

	Harvesting Period	1924-25 Tons	1923-24. Tons.	1922-23. Tons
Germany	Sept.-Jan.	1,600,000	1,146,891	1,455,078
Czecho-Slovakia	Sept.-Jan.	1,500,000	1,001,049	734,856
Austria	Sept.-Jan.	74,000	47,321	24,468
Hungary	Sept.-Jan.	200,000	122,588	81,603
France	Sept.-Jan.	810,000	490,850	492,705
Belgium	Sept -Jan.	400,000	300,121	268,928
Holland	Sept.-Jan.	330,000	231,923	255,592
Russia (Ukraine, etc.)	Sept.-Jan.	450,000	366,742	193,400
Poland	Sept -Jan.	480,000	389,995	301,890
Sweden	Sept.-Jan.	140,000	153,890	71,790
Denmark	Sept.-Jan.	136,000	102,358	88,382
Italy	Sept.-Jan.	425,000	351,102	297,280
Spain	Sept.-Jan.	255,000	185,063	160,035
Switzerland	Sept.-Jan.	6,000	5,500	6,033
Bulgaria	Sept.-Jan.	40,000	26,566	16,250
Roumania	Sept.-Jan.	90,000	71,826	49,872
England	Sept.-Jan.	21,700	13,280	7,011
Other Countries	Sept.-Jan.	217,300	50,696	69,152

United Kingdom Monthly Sugar Report.

Our last report was dated the 9th February, 1925.

The market throughout the period under review has maintained the firm tone which started last month, and prices are generally 9d. to 1s. per cwt. dearer.

Business on the terminal market has been on a much larger scale, and the recent innovation of reducing the market fluctuations to ¾d. instead of 1½d. has tended to make the market more liquid. Tenders in February were small and so far the tenders on March contracts have been under 2000 tons. February was finally liquidated at 18s., March was dealt in from 18s. to 18s. 3d. to 17s. 9d. to 18s. 3d. to 17s. 9d. to 18s 5¼d., May sold from 18s. to 18s. 4½d. to 17s. 9d. to 18s. 7½d. to 17s. 10½d. to 18s. 9d. A large business took place in August from 18s. 1½d to 18s 9d. to 18s. 4½d. to 19s. New crop was also very active, October/December and December sold from 18s. to 18s. 9¾d. The latest prices are March 18s 4½d , May 18s. 6¾d., August 18s. 9d., October/December 18s. 7½d.

Trading in actual sugars has continued to be good and the demand has constantly absorbed all offers of foreign sugars in spite of the cheaper prices of British Refined Fine Granulated on the spot has advanced from 31s. 3d. to 31s 11¼d. duty paid, less 1½ per cent. The scarcity of lower-grade Granulated is more marked than ever and it is almost impossible to give an accurate quotation for this class of sugar. The Home Grown sugar is now practically all sold out and only isolated quotations continue to be made. White Javas have advanced in price in sympathy with the world's parities but it is more difficult to find buyers at the higher level, May/June shipment has advanced to 18s. 4½d., June/July shipment to 18s 1½d., and July/August to 18s., all c i.f. U K. Canadian Granulated sold from 18s 9d to 19s. 1½d. c.i f American Granulated sold from 19s. to 19s. 4½d. c.i.f., at which latter price there remain sellers for March/April shipment. Czecho Granulated for ready and March/April shipment sold from 18s. 4½d to 18s. 10½d., but to-day's price is 19s. A fair business was also done in Dutch Granulated from 18s. 4½d to 18s. 10½d., but to-day they are asking 19s. 3d. There is very little demand for forward but a few transactions have taken place at 1½d. to 3d premium over the ready quotation. German Sugars have not been offering as the prices ruling in that country are at a much higher parity. Belgian Granulated and Crystals have advanced from 18s. to 19s , but little or no business has been done in these descriptions.

The British refiners continue to buy Cuban 96 per cent. up to 14s. 4½ c.i.f., and a fair business was also done in British West India 96 per cent. at 15s. 10½d. c.i f., but they have not followed the recent advance. Cubans are not quoted to-day under 15s. c.i.f , but so far no business has been reported at this price.

The U.K. refiners by their low prices have attracted a considerable portion of the business, and in spite of the heavy demand for their sugar they only reluctantly advanced their prices. On 27th February they quoted 3d. higher, and again on March 9th they advanced a further 3d. To-day they are still actually cheaper than foreign sugar and they are evidently acting on a determined policy to regain some of the trade that was lost to them in the latter part of last year. The latest quotations are No. 1 Cubes 37s., London Granulated 32s. 10½d., duty paid.

A good business has been done in America and the refiners have bought large quantities of Cubans, Porto Ricos, and Philippines. Over the period the market has been raised from 2⅞ to 3⅛ c.i.f. New York, and the latest transactions have taken place at 3 1/16 for March shipment.

The Cuban crop continues to make good progress and the receipts to date are over 200,000 tons more than last year. The yield is reported to be improving and the labour troubles are now settled again. The Cuban Department of Agriculture has issued an estimate of 4,470,000 tons, but the official statisticians have still made no change in their estimates although it is now generally accepted that the crop will be nearer 4,500,000 tons than 4,700,000 tons.

21, Mincing Lane,
London, E.C. 3.
March 10th, 1925.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 316. APRIL, 1925. VOL. XXVII.

Notes and Comments.

The Beet Sugar Subsidy Bill in Parliament.

During the past month the British Sugar Subsidy Bill has been carried through its Committee stages in the House of Commons and also received a third reading; subsequently it has been sent up to the House of Lords and finally passed into law.

What opposition there was was chiefly directed to the supposed danger of a huge State-aided sugar trust being formed in this country, and it was urged that the Government should exercise the right for the State at the end of the ten-year period to be allotted shares in the companies to the amount of the subsidy paid, thereby making the community shareholders in the success of the undertaking. But the Government refused to consent to any State holding in the new ventures, Mr. WOOD, the Minister for Agriculture, pointing out that their main aim was to assist agriculture in this country, and not to bring the State into direct participation in the profits. The Government also refused to allow the clause about 75 per cent. of the machinery being British to be omitted, since, as was pointed out by Mr. WOOD, power was reserved to the Minister by which, if he was satisfied there was good reason, he could dispense any particular factory from the obligation. But the Government agreed to two new clauses: one providing for the auditing of the accounts of any factory receiving the subsidy, including a statement of profit and loss, so that the State and Parliament could be kept informed as fully as possible of the progress of the undertakings; the other ensured that the wages paid to workers in the manufacture of sugar where a subsidy was payable should conform to the fair wages resolutions of the House of Commons, and in the event of dispute be referred to an Industrial Court for settlement.

Imperial Preference on Sugar: Budget Expectations.

The Home Beet Sugar industry has had a long innings in Parliament, and many of our readers will agree that it is time the Colonial cane sugar industry got a turn. As we anticipated last December, it has had to wait for the 1925 Budget announcement, because the Preference is already in existence and it is a matter for the Budget to alter. While Budget secrets are usually well guarded, it is not difficult to anticipate what the Government's preference proposals will be, for it was hinted at the time of the General Election last autumn that the resolutions passed at the Imperial Economic Conference in London, in October, 1923, would form the basis of a stabilized preference to British Colonial sugar. At that Conference the then Government of Mr. BALDWIN offered to guarantee that if the sugar duty were further reduced the preference should for a period of ten years not fall with it, but be maintained at the rate of practically one halfpenny per lb., so long at least as the duty on foreign sugar did not fall below that level. We may, therefore, confidently assume that when the Budget resolutions are unfolded by Mr. CHURCHILL at the end of April, his provisions for assisting Colonial cane sugar will not vary greatly, if anything, from the offer made in October, 1923. If there is any unexpected feature it is more likely than not to lie in an increase in the amount of the preference.

As is known, the Government of 1923 suffered a severe eclipse at the polls a month later, and the result was the entry into office of a Minority (Labour) Party, who consequently had the task of framing the 1924 Budget. Mr. SNOWDEN, it will be remembered, decided to reduce the sugar duties drastically, in effect from 25s. 8d. per cwt. to 11s. 8d., or by 1½d. per lb. The result was that the Colonial preference of one-sixth off was reduced from 4s. 3d. to 1s. 11d. per cwt., or from slightly under ½d. per lb. to $\frac{5}{24}$ of a penny per lb. If now Mr. CHURCHILL fulfils anticipations by restoring the preference to ½d. per lb., it means more than doubling the preference allowed by Mr. SNOWDEN. And if, as likewise anticipated, he proposes to stabilize it for say ten years, he will probably do the Colonial sugar interests more good than if he grants them a rate of preference that is liable to fluctuation or to reduction in the course of a short time.

Obviously no Government can pledge the future save during the years it is in office. But in view of the fact that Mr. Baldwin's new Government has "stepfathered" the policy devised by the late Labour Government of giving a ten-year period of assistance to the home beet sugar industry, it can hardly be supposed that if four or five years hence the Labour party come into power again, they will on their part refuse to honour a similar undertaking devised for the cane sugar industry. It may therefore be taken as fairly certain that both beet and cane production in the Empire is in for a period of stabilization in respect to preference such as it has never yet possessed, and which will go a long way to encourage an increase of production, always providing of course that no violent fluctuations in world prices upset the industry. The best remedy against this is of course a wider spread production, so the sooner the Empire succeeds in increasing its output, the less it will have to fear from market disturbances, whether due to monopolies or to the failure of some predominating crop like that of Cuba, Java or Continental beet.

Cane Variety Work in Tucuman.

On another page we publish a valuable account, written by Dr. W. E. CROSS, of the cane variety work in Tucuman, from its inception to the present day. As everyone knows, the prosperity of the industry rests almost entirely on the basis of this line of work. The present position is that POJ 36 and 213 are practically the only kinds of cane grown commercially, while up to a few years ago the industry was dependent on two so-called native canes similar to those grown in Louisiana for many years. The change has appeared to the outside sugar world to be somewhat dramatically sudden, and might appear to be a comparatively easy piece of work. But, reading between the lines, it is obvious that a great deal of time and labour had to be devoted to the subject both by Dr. **Cross** and his predecessors, and that many other lines of improvement had to be first explored. Such improvements are not easy in any industry, and the various preliminary stages in the Tucuman history are disposed of in comparatively few lines. As POJ 36 and 213 have now the fields to themselves, and are thoroughly permeated with the mosaic disease which overthrew the former varieties grown, there is little to be feared from the introduction of this disease into the country, while an excellent opportunity is offered for testing the liability to infection by the new kinds which are constantly being brought in, as well as segregating immune and mosaic-free kinds on isolated plots. In these circumstances, in fact, it is possible to take up a bold line with regard to the introduction of desirable canes grown in other countries; and Tucuman appears to have utilized this method to the full, with the result that it has probably got together more mosaic resistant and immune varieties than any other country, hedged in as they are with numerous necessary restrictions. Meanwhile, the full machinery of quarantine is available; for the introduced canes are subject to examination both on entering the country and on entering the State of Tucuman; so that a keen look-out is maintained against the possible slipping in of other pests and diseases. We congratulate Dr **Cross** on the excellent work being done, the independent line which he has taken up, and the accumulation of such a valuable collection of cane varieties at his Tucuman Station.

Incidentally, we may here refer again to a point which we have often raised before. There seems to be a unique opportunity for that systematic classification of the sugar canes of the world which has so long been a desideratum. The work of examining the varieties is in the capable hands of Mr. G. L. **Fawcett**; and we wonder whether it will be possible to separate the thick tropical canes into such classes as have shown themselves to exist in the north Indian forms. The whole sugar world would welcome any light which may be thrown on this difficult subject.

The Sugar Crop Outlook in 1925.

Messrs. **Willett & Gray**, the New York sugar statisticians, discussing the outlook for 1925 in Europe, state that at the moment only rough estimates can be made as to the extent of the sowings that will be effected in Europe during the coming campaign. The latest talk in European circles, they say, is that "there will be a slightly smaller acreage planted in Germany and that there is a possibility of a decrease in France of 15 per cent. and in Czecho-Slovakia of 5 per cent. to 7 per cent. However, it is much too early to talk in definite figures. It has been estimated that the consumption of sugar in Europe this year will approximate 8,500,000 tons, and as there is a production in Europe of 7,175,000 tons, according to latest estimates, Europe, particularly the United Kingdom, should have to draw on other countries for 1,325,000 tons to make up the deficiency. Of course, Cuba is the main source to fill this deficiency, but the quantity of Cubas is dependable on the amount of Preferential sugars available for the United Kingdom, as well as the extent of competition of such countries as Java, Peru, Brazil, etc. As far as the United Kingdom is concerned, there is legislation pending increasing the amount of preference in duty allowed British grown sugars and this has a tendency to increase such imports. It is estimated that 225,000 tons of British Preferential sugars will be imported by the United Kingdom and that 725,000 tons of Cubas and San Domingos will go to the United Kingdom and the Continent, and the balance of the 1,325,000 tons will be accounted for by Javas, Perus, Brazils, and Canadian and American refined."

Death of Mr. Robert Harvey, of Glasgow.

We regret to have to record the passing away in his 76th year of Mr. Robert Harvey, late chairman of the Harvey Engineering Co., Ltd., of Glasgow. He was a well-known personality in his day in the cane sugar industry throughout the world, and in the course of his wide travels on behalf of his firm he made friends in every cane sugar country. All his life was spent in connexion with sugar machinery engineering, though it is probable that but for the fact that his father was in the same line of business before him, Robert Harvey's own inclinations would have led him to become an artist by profession, for he was a painter of considerable ability, and the writer has pleasant recollections of being shown an interesting and extensive collection of water-colours painted by Mr. Harvey in the various sugar countries to which his professional work took him. He was nevertheless a good engineer, and as his firm descended through a number of partnerships and amalgamations from James Cook, the founder of the sugar machinery industry in Glasgow, who started business as far back as 1788,[1] it had an experience and prestige in the sugar world that stood the Harveys in good stead. Nearly ten years ago Mr. Harvey had a breakdown in health which led to his retirement from the management of the Harvey Engineering Company and also from the position of chairman. Since then he has lived in retirement in Glasgow. His death severs a link with old days when Glasgow held undisputed sway in the world's sugar machinery market, and none will regret it more than those of our senior readers who knew him personally and appreciated his courtesy and geniality.

Death of Dr. G. L. Spencer.

Sugar chemists, and indeed all connected with the technology of our industry, will learn with regret of the death of Dr. Guilford L. Spencer, who died suddenly on March 23rd, as the result of heart affection, while travelling in Cuba. This news will come as a shock to his many friends, and the sugar industry at large will deplore the loss of one who has done so much in establishing its scientific control.

He had been associated with the Cuban-American Sugar Company since 1906, at first in the capacity of chemist to one of the factories of the group belonging to these interests, later as chief of the central control laboratory, and at the time of his death as director of manufacturing operations at the Chaparra, Delicias, San Manuel, Tinguaro and Neuva Luisa centrals. Dr. Spencer had a distinguished career, and had graduated B.S. at Purdue University and M.S. at the University of Michigan. He had served as assistant to Dr. Harvey W. Wiley at the time when the well-known investigations on the value of the diffusion process were being carried out at Magnolia plantation, La. He had also been Chief of the Sugar Laboratory of the Bureau of Chemistry, Washington. He was well known as the author of "A Handbook for Cane Sugar Manufacturers and their Chemists," a very excellent small work, issued in English and Spanish, and also of a companion book for the beet sugar chemist. He was in his 67th year.

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[1] For an account of the rise and progress of the sugar machinery industry in Glasgow, we cannot do better than refer our readers to a paper appearing in our issues of February and March, 1917, from the pen of Mr Robert Harvey. A few copies of the reprint of this paper are still in our possession and are available for any applicant amongst our readers who may desire to possess a copy.

British Machinery for the Ipswich Sugar Factory.

The insistence on the part of the Government that the granting of a subsidy on home-grown sugar shall ordinarily be contingent on the machinery of the sugar factory being, as to 75 per cent., of British manufacture is bearing fruit. We are glad to learn that the well-known firm of British sugar machinery manufacturers, Messrs. Fawcett, Preston & Co., Ltd., of Liverpool, have secured the contract for the erection of the beet sugar factory about to be installed at Ipswich by the Anglo-Dutch group: and they are providing a large proportion of the machinery for it, including the vacuum pans, vacuum and other pumping engines, crystallizers, etc. This factory is to commence work in October next; it is, it will be remembered, the third factory of this Anglo-Dutch group, the other two being Cantley and Ely (which latter will likewise start operating next autumn). The Ipswich factory is intended to deal with 1200 tons of beet in 24 hours, producing white sugar as well as dried pulp.

In addition to Ipswich, Messrs. Fawcett, Preston & Co., Ltd., have also been successful in securing orders for machinery for the Ely factory.

A Double-Crusher Patent Lawsuit.

We learn that the Fulton Iron Works Company of St. Louis, United States, have filed a suit in the American law courts against the Farrell Foundry and Machine Company of Ansonia, Conn., U.S.A., claiming infringement of a Fulton Patent (U.S. Patent 1,291,095 of 1919[1]) covering a crushing device used in the manufacture of raw sugar from cane and known to the sugar industry generally as the Fulton Patented Double Crusher. Although this lawsuit is between two American firms in the American courts, the verdict given may have a wider repercussion, for apart from American manufacturers there are several British engineering firms who are interested in producing Double Crushers, and since the Fulton design has, if we mistake not, been patented in most countries of the world, the establishment of the legality of the Fulton patent in the American courts would not only result in the barring of all other designs from use within American territory, but would probably lead to action being taken in other countries also where infringements are alleged to be perpetrated.

In the United Kingdom when a case is filed for a lawsuit the matter becomes *sub judice* and comment on the matter is precluded, while the publication in the press beforehand of the claims and counter-claims of the two parties to the action is not allowed. But in the States a different degree of latitude is clearly allowed, and the Farrell Foundry and Machine Company have already published in the American sugar press their grounds for resisting the claim of the Fulton Iron Works Company.

These grounds are stated in an advertisement appearing in this number. Briefly put, the firm are disputing the validity of the patent on the alleged grounds that the subject matter did not involve the exercise of invention and that it was not novel at the time of its invention. The Fulton patent appears to consist of two pairs of rolls in which the first pair are grooved differently from the second pair, while in the alleged infringement on the part of the Farrell firm the rolls of both crushers are grooved identically. In the United States it is not possible to patent a duplication, and the U.S. court will probably be asked to decide whether the duplication of a single crusher with a different grooving in the second one constitutes a valid patentable invention which excludes the duplication of crushers by other firms even when the two pairs of rollers are grooved in identical fashion. The single crusher was seemingly patented by KRAJEWSKI as far back as 1886, so the essence of the Fulton patent seems to lie in the duplication of the crusher accompanied by variations in the grooving of the rollers.

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[1] *I.S.J.*, 1919, 471.

As above said, the verdict of the American courts will be awaited with considerable interest by other designers of sugar machinery than the firms directly concerned in the pending lawsuit; and if Messrs. FULTON win they will by confirming the validity of their American patent go some distance towards establishing its rights throughout the sugar world, quite apart from the question as to whether the validity can be similarly substantiated in the courts of other countries. In other words, the moral effect of such a victory will probably assist them in disposing of other alleged infringements without necessity to have recourse to the laws of each country concerned. On the other side, if the Farrell firm win their case and prove that this is not a good invention, they will have done a good turn to all those other makers of double crushers for the sugar industry who rightly or wrongly deem that their own designs are valid.

The American Sugar Refining Company.

The Report of the American Sugar Refining Company for the year 1924, which has just been issued, is briefer than usual in its comment on sugar affairs generally. The year in question was again profitable for sugar producers, but like the preceding year was most unfavourable for profitable refining operations. In 1922 the Company refined 1,650,000 tons of raw sugar at a profit of slightly over ten million dollars; in 1923 they refined 1,162,000 tons at a loss of $1,693,070; in 1924 the same tonnage as in 1923 was refined at a loss of $327,637. This loss on refining operations was again caused by the frequent fluctuations in the prices of raw sugar, with a downward trend of prices throughout the greater part of the year. The extreme fluctuation was less than in 1923, but even then was 2·8125 cents per lb. during the year, or greater than the extreme fluctuation of the ten years before the war taken as an entirety. In other words, in 1924 the Company faced the price extremes of a ten-year pre-war period. For a large part of the year it was impossible to purchase raw sugar, convert it into refined and dispose of it, save at a loss.

This was the second full year's operation of the new Baltimore refinery. It melted during the year a total of 275,000 tons of raw sugar and was under continuous operation. The efficiency of this new refinery gives the greatest satisfaction to the Company.

Of the Cuban properties, Central Cunagua completed its seventh campaign and Jaronu its third; the former produced 555,260 and Jaronu 471,072 bags of raw sugar of 325 lbs. each, while the joint production of final molasses amounted to 7,857,164 gallons. The results of the 1924 year as regards Cuba were most satisfactory.

Messrs. Fairrie & Co, Ld., the Liverpool refiners, recently offered to adapt one of their refineries for working up sugar beets if they were guaranteed 5000 tons of roots this season by the Lancashire farmers. Owing to an insufficient response by the latter, the refiners have had to abandon their proposal; but the Farmers' Committee have since come to an arrangement with the Sankey Sugar Company of Earlestown, Lancashire, who offer to pay at the rate of 49s. per ton delivered at growers' station for all the roots that the Lancashire farmers can grow this season. Meantime an intensive campaign is to be conducted amongst the farmers to encourage a much bigger output of beetroot.

Fifty Years Ago.

From the "Sugar Cane," April, 1875.

ALFRED FRYER had an article in this issue of our predecessor calling attention to the defects of the process of sugar manufacture as carried on about that time, or perhaps somewhat previous to it, describing it, in fact, as "the most barbarous of the arts." Especially did he denounce methods of evaporation, and the following is an extract from his writing:—

"A form of vessel was selected which presented the greatest capacity and smallest heating surface; and, as if in order to subject the juice to further injury, a battery of vessels of this character were arrayed, which required the juice to be under treatment for hours in succession, and by the device of ladling the syrup from vessel to vessel, portions introduced in the morning remained (mingled with more recently added juice) at the close of the operations of the day. It remained only to apply the fire in its full fury to that portion of the battery, the contents of which would suffer most from its action, to complete a system, the folly of which is unrivalled in technology. Not only is the method as bad as it ever entered the heart of man to conceive, but it is costly. The number of men and girls about a boiling house employed in skimming and potting is out of all proportion to the sugar made. Nor does the waste end with the process, much of the juice is left in the cane, and of that which is not converted into caramel and molasses by the fire a considerable portion is destined to drain away in the ship's hold." Analyses made of the juice during its concentration in the grand copper, middle copper, and tayche had shown 10·7, 15·0, and 22·7 per cent. of glucose (reducing sugars) all calculated on the dry matter; whilst in another part of this issue of the *Sugar Cane* it was stated that 20 tons of cane were required to make 1 ton of raw sugar, so that the state of things must indeed have been bad.

After this followed some of the advantages of the "Concretor," in the sale of which the writer was of course interested. "In it the juice is under treatment during minutes instead of hours. The heated surface is the greatest, and the solid content the least that complete access to the vessel admits of. The light and mobile juice receives the full stress of the fire. As it thickens, it is brought under the influence of more moderate heat, and before its consistence is such that the feebler heat of an exhausted fire could scorch it, it is removed from its action and the remainder of the concentration is effected by the gentle action of heated air applied to the surface of the syrup, and this concentration is effected at a temperature lower than that usually maintained in the vacuum pan. The product is clarified juice divested of its water. It loses very little by drainage, caramel has not been made, and molasses is absolutely abolished . . . ."

But the particular purpose of the article was to recommend the adoption of the "Concretor" in conjunction with the vacuum pan. It had already been done to some extent, and extracts from letters from manufacturers using the apparatus in this way were reproduced. One had compared results on two estates, the first making sugar by two open batteries, and the second by the Fryer's patented concretor trays. He had observed that the syrup from the first was very dark, requiring the addition of five parts of water to one of syrup to bring it to the original tint of the clarified juice; whilst in the case of the syrup from the second, only two parts of water were necessary for restoring the original colour.

The Economics of the Natal Sugar Industry.

The environmental conditions of the sugar industry are almost unique in Natal (with Zululand). The sugar cane tract is well outside the tropics; but thanks to the warm Mozambique ocean current, a branch of the south eastern trade current diverted southwards on its impact with the coast of Africa just north of Madagascar, the climate is much warmer than that in similar latitudes on the opposite side of the continent. This is well illustrated by the line on the vegetation map showing the southern limit of the palm zone. This line strikes the west coast about 21° south latitude but, after passing round the north of the Kalihari desert, as it approaches the east coast it bends sharply southwards; it then follows the coast line as far as Port Elizabeth in the extreme south of the Cape Colony, and then proceeds across the Indian ocean to the western coast of Australia. These warmth-loving and in the main tropical plants can thus be grown 1000 miles further south on the Natal coast than on that of South West Africa. Sugar cane requires a greater amount of heat than some of the palms, but it too can be grown much further south in Natal than would otherwise have been the case. Louisiana and north India, both also within the palm belt, are at a disadvantage as regards Natal in that they have a marked cold season; in Natal the climate is much more equable throughout the year. It thus happens that, while in the two countries named the growing period of the cane is strictly limited to the short summer season of intense heat, in Natal the cane can grow all the year round, although of course less rapidly in the cooler season. But the environmental conditions of Natal would appear not to be ideal for the growth of the more tropical cane varieties, and it is dependent for its sugar production on a non-tropical form hailing originally from north India; and even this form requires two full years to complete its growth so that the juice may reach its maximum of sweetness. Natal then at present grows a cane which in all other countries is considered somewhat inferior, and it is probably the only cane-growing country which relies solely on one variety for sugar production. The selection of this cane for Natal has however fully justified itself, in that it produces much better juice than in the country of its origin and, in the two-year period, also yields a far greater tonnage of canes. These facts, together with the great strides which have been taken by the industry during the past twenty years, have led to a considerable amount of interest in the sugar world; and the gaps in our knowledge of the conditions prevailing in the Natal sugar fields are being rapidly filled up.

In a recent paper Duncan M. Eadie,[1] the general secretary of the South African Sugar Association, reviews the industry chiefly from the business point of view, and gives a useful summary of its economic structure. This paper, which is here abstracted, should be read by all who are interested in the economics of the cane field and, now Natal has definitely entered on the exporting stage, in the possibilities of increasing the world's production of cane sugar, so much to be desired at the present time. He prefaces his remarks by the observation that sugar production presents a unique feature in the industrial world, in that the grower of the raw product must be alongside of the manufacturer of the finished article. These two, the farm and the factory, whether capitalized separately or con-jointly, must work together for the common good: rivalry or disagreement is likely to be fatal to both. The rise in production has been rapid. From 1893 to 1903 about 20,000 tons of sugar were made; in the next decade there was a steady increase till 92,000 tons were reached; and during the past ten years the pace has been accelerated, and an average yield of 200,000 tons is well in sight. If all goes well, there promises to be some further increase, and a quarter of a million tons per annum is considered a possible figure in the near future.

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[1] Louisiana Reference Book. July, 1924.

The climate partakes for part of the year of a tropical character, in so far that rain falls in fair quantity during the summer, which is the growing season. On the other hand, the extremes of temperature characteristic of most regions in the tropics are absent in Natal, and living conditions are thus favourable to the white settler. The mean average temperature for the year is 71°F., with 65° in midwinter and 77° in midsummer; and the rainfall averages from 35 to 50 inches, of which 60 to 75 per cent. falls in the summer months. These conditions are, however, restricted to a narrow belt of coast land extending from 28° to 31° south latitude, on either side of Durban, a total distance of some 230 miles. The industry is rendered possible over this wide stretch by a railway running the entire length near the sea. In present conditions it is recognized that cane growing is economically possible for a distance of eight to ten miles from the railway. The sugar tract is not, however, yet exhausted, there being still many thousands of acres which could be rendered available by a slight extension of transport facilities, especially towards the north where the line is being pushed further on and slightly further from the coast.

The economic structure of the industry is somewhat complicated, owing apparently to various extensions at different times, and all stages exist between planters also owning factories and various forms of cane farming, in which the planters own or lease the land independently of the factories which are the property of separate individuals or companies. The factories vary in capacity from 500–1000 tons of sugar a year to as much as 20,000, the general tendency being in favour of the larger ones. At present there are 27 mills in the sugar belt, five in Zululand, 14 in Natal north of Durban, and eight to the south of that town. In spite of all attempts on the part of the Government to interest natives or Indians in the manufacturing side, practically all of the factories are owned by Europeans. The total crushing plant is capable of dealing with 2½ million tons of cane during the reaping season, from the beginning of May till the end of December. All the factories save one use the sulphitation process, as this is considered to be more suitable to the kind of juice produced. Several refineries have from time to time sprung up in Durban which, although rather to the south, may be regarded as the centre of the industry, but only one of these now remains.

A good farmer on good land may look for a harvest of 30 tons from his plant canes, which mature in two years; first ratoons will with reasonable treatment produce a like crop, and second and third ratoons are usually grown with success. After that, say eight years from planting, it is generally found desirable to renovate the land and replant. Where cane farming is in vogue, the planter is paid by weight of cane sent in, and the various methods mentioned of arriving at the rate at which he is paid are rather bewildering to the outsider. The general principle seems to be that a certain basal figure is arrived at by mutual consent, with a sliding scale which rises or falls according to the price received by the factory for its sugar. In spite of occasional friction, this method appears to be satisfactory to both parties, recourse to legal settlement of difficulties being rare.

Although there are still some thousands of Indian coolies working on the plantations, the natives of the country provide practically all of the unskilled labour in field and factory. This labour has its peculiarities. The native seldom looks out for a job, and a great system of recruiting has sprung up. When recruits come from a distant kraal or country the law requires proper quarters and food, with medical attendance. The houses are not elaborate structures, and and the ordinary food required is easily obtainable; as the native is generally healthy,[1] medical attention is not usually a very great burden. The wages of adult labour is 1s. 8d. per diem., and the food costs from 4d. to 6d.; thus with recruiting charges the man-day should not exceed 2s. 6d. But a considerable part of the work is done by youngsters which brings down the average pay to about 2s.

Transport forms a considerable item in the planter's costs. It is usually effected by ox or mule wagon, with light field line and light trunk line to the Government railway or to the mill itself. When concessions of land are made to planters in connexion with a mill, trams are laid down by the latter to supplement the field transport, which is usually by ox or field wagon. The cost of transport varies of course with distance from mill. On the railways a trip of average length costs about 1s. 6d. per ton of canes. Tram line charges vary with length of line and intensity of traffic, and in the concessions range from 1s. to 3s. per ton. The author points out that the use of wagons for any distance is costly, because of the low ratio of load to capital invested. A wagon with oxen and gear costs £150 to £300, and its daily efficiency works out at about three tons for ten miles. Thus, to fill a truck of 25 tons from this distance means a capital outlay of £2000, with £1 a day for wages of the men in charge.

The Natal production of sugar has rapidly overtaken the consumption in the Union of South Africa. Previous to July, 1923, Mozambique sugar was allowed to enter the Transvaal free of duty, but now it is saddled with import dues, and also deprived of preferential transport rates on the railways in the Union; and therefore 15,000 to 20,000 more tons of sugar are required from Natal. In recent years, with a crop of 150,000 tons, 30,000 tons were available for export; now, with a 200,000 ton crop, over 50,000 will be available for this purpose. Practically all sugar exported is sent to the United Kingdom, where the preferential duty enables it to find a market. This advantage works out at 3s. 10d. per 100 lbs. of sugar, and is expected to last for the next ten years. It is anticipated that, shortly, the total production will reach 250,000 tons, under prevailing conditions; and even a higher figure is likely to be reached, if fertile land at present beyond reach of the railways is opened up. Thus the exporting side is likely to be an increasingly important factor in the industry in the near future. In order that the planter may have a reasonable certainty of obtaining a fair price for his canes, some form of central selling is a necessity.

Experience has shown that the growing of sugar cane is by no means the least profitable form of farming in South Africa. It is a single crop with a certain market, and the price paid is calculated on a tangible basis, namely by weight. But all the eggs are in one basket, and thus the control of disease becomes important, and the plantations are to some extent dependent on fluctuations in world prices. Such factors as have been mentioned are moreover liable to the restriction of individual genius in using capital and labour, while price by weight makes the improvement of the character of the cane of no value, leading to agricultural stagnation. This is especially the case with the concession planters in Zululand, whose agreement has been fixed for 25 years. These and other problems are beginning to emerge as development increases, but the author is hopeful that, in turn, they will all be satisfactorily solved, to the immense advantage of the industry as a whole.

C. A. B.

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[1] See, however, *I.S.J.*, 1924, 580.

Modifications of the Bach Process of making White Sugar.

By C. F. ARMSTRONG, F C.S

White Sugar Processes in General.

Most of the processes for making white sugar direct from cane juice or melted raw sugars are divided into two principal divisions:—

(1) Those in which a heavy precipitate is formed to carry with it most of the impurities present and to render the liquor capable of rapid filtration;

(2) Those which affect the necessary bleaching of the liquor, for, unfortunately, the persistent yellow pigment which is always present in cane products is not removed by filtration. The writer has been fortunate in having had experience with a new up-to-date plant, attached as a refinery to the Antigua Sugar Factory, this plant utilizing the Bach process.

Bach's Process.

During the first run the process was operated strictly in accordance with the inventor's instructions, as follows:—Raw 96° sugar was washed to 98° polarization, melted up to a density of 27° Bé., and heated to 70°C. The liquor was pumped to sulphitators, where milk-of-lime at 15° Bé. was added to the amount of 28 gallons to each 1000 gallons of liquor. This was then sulphured to an acidity of 1·7 c.c. N/50 NaOH, using phenolphthalein as indicator. During the sulphitation the liquor was kept in motion by a suitable stirring gear, and on completion of the operation, the liquor was heated to 95°C., and pumped through filter-presses, the time taken for each sulphitation of 1000 gallons being 20 mins.

A brilliantly clear yellow liquor was the result of this filtration, and the resulting press-cake was hard and capable of easily being washed to a sugar content of practically nil. The sugar made was of good colour, equal to superior carbonatation sugar. No appreciable inversion of sucrose could be observed.

The Bach process is clean, neat, and cheap, once the plant has been installed; but has the following disadvantages, which are dealt with in the order noted below.

The first feature noticed was the turbidity of the molasses from the first strike, and it was concluded that this was due to the formation of a small quantity of calcium bisulphite during the sulphitation and the consequent formation of calcium sulphate.

$$\begin{aligned} &\mathrm{Ca\,SO_3 + SO_2 + H_2O = Ca\,(HSO_3)_2} \\ &\mathrm{Ca\,(HSO_3)_2 = Ca\,SO_3 + H_2SO_3} \\ &\mathrm{2\,Ca\,SO_3 + O_2 = 2\,Ca\,SO_4} \end{aligned}$$

Endeavours were therefore made to prevent over-acidification[1] in the following ways:—(1) By using compressed air in each sulphitator to ensure complete mingling of the lime and sulphurous acid gas; and (2) by reducing the sulphitation to neutrality to phenolphthalein.

In spite of this there was still turbidity in the molasses, proving that however much care is exercised a certain amount of the normal calcium sulphate ($\mathrm{Ca\,SO_3}$) formed will be converted into the soluble calcium bisulphite, $\mathrm{Ca\,(HSO_3)_2}$. The effect of this precipitation is, of course, a darker molasses and a far too early return of molasses to the raw house. Thus, with this method of working we could only run up to B4 strikes, after which the molasses had to be returned.

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[1] The required acidity needs explaining However carefully milk-of-lime is prepared it will be found that some particles of free lime escape slaking and become coated with calcium saccharate Then, under pressure in the presses, this compound breaks up, and the free lime practically neutralizes the original slight acidity of the unfiltered liquor.

MODIFICATION OF THE BACH PROCESS.

First modification.—Attempts were then made to stop the formation of calcium bisulphite by sulphitating to slight alkalinity; then, using phosphoric acid, to bring the liquor up to the required acidity. This answered admirably, and the turbidity troubles were at an end.

A subsequent refinery run was worked on this method, i.e., using phosphoric acid in conjunction with the lime and sulphur. The recovery was better, but the colour of the sugar was still not good enough to compare with American granulated, due, of course, to the persistent yellow pigment present.

Second modification.—A further advance on the original Bach process was made during this run, namely, by treating the molasses (which owing to its colour was to be returned to the raw house) in the same way as the raw sugar, viz., by putting it through the Bach process. This worked very well, and the resulting syrup was brilliantly clear, having lost a considerable amount of colour.

Next, the question arose how to get rid of the yellow coloration. It is evident that this colour should be completely absorbed, not temporarily bleached; and this, as far as I know, can only be done by using bone char or a vegetable carbon. The use of bone char is impossible in most tropical countries, so we are left with the choice of vegetable carbon. This answers the same purpose as bone char; but, at present, is difficult to deal with, being, generally, a fine impalpable powder. Special plant and filters have to be installed therefore for its use. It struck the writer that there should be no reason why vegetable carbon should not be used in conjunction with the Bach process.[1]

Third modification.—After the liquor had been limed and sulphured, a certain quantity of vegetable carbon was added to the muddy liquor; when, after stirring and heating, the liquor was pumped through the presses.

The filtrate was brilliantly clear, and *water white*, whilst the carbon was completely retained in the press-cake. The resulting sugar was very good in colour; and, I am informed, as good as Czecho-Slovakian "R.P.N." During this run we were able to run the number of strikes up to B7 without any appreciable lowering in the colour of the sugar. Unfortunately the refinery had to be closed down rather abruptly, and the number of times the molasses produced could have been returned was not ascertained. However, the last strike boiled contained no raw sugar syrup, but was boiled only on the molasses from the preceding six strikes, the colour of the sugar being as good as the first strike. The amount of carbon used was 0·5 per cent. on the raw sugar melted, the cost of which came to $1·95 per ton of white sugar actually made.

The carbon used of which there happened to be a small amount in stock was an inferior brand, and therefore the quantity required was higher than if one of the better known grades (such as "Norit," "Suchar" or "Carboraffin" had been available. Laboratory experiments proved this.

The figure $1·95 per ton is calculated on the amount of white sugar made, and would have been still less if the refinery could have been kept running continuously. Also, it should be remembered that we were treating sugar polarizing only 97·8°, whereas, if we had been treating sugar polarizing 99°, the amount of carbon used could be reduced by 50 per cent. A disadvantage attached to this modification is that the carbon is completely lost. Tests were made throughout this run for inversion of sucrose, but this was, if anything, less than in the ordinary Bach processs.

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[1] Filtration of the molasses in the same way as the syrup and using a little carbon in combination with the Bach process is not a new modification. Success in the use of carbon in combination with the Bach process depends largely on the quality of sugar to be turned out. The Bach process alone without the addition of a relatively small amount of carbon will not produce a sugar equal, for example, to Czecho-Slovakian "R.P N."—ED., *I.S.J.*

DIRECT CARBON PROCESSES.

I conclude with a few observations on the claims made for a direct vegetable carbon process using no auxiliary clarification.

Firstly, it is claimed by vegetable carbon makers that only 1 per cent. carbon need be used per ton of white sugar, and yet they recommend that carbon should be added at the rate of 2·5 per cent. of the raw sugars in the first melt. They arrive at their per cent. figure by saying that the 2·5 per cent. carbon can be used several times. I do not see how this can be conclusively proved where the practice is to return high purity molasses to the raw house.

Secondly, each maker of carbon lays down the law that raw 96° sugar must be washed up to 99° polarization. The fact that 99° sugar contains 50 per cent. less impurities than 98° sugar is sometimes lost sight of.

A process of making white sugar using only vegetable carbon has, I think, the following disadvantages :—The sugar has to be washed up to 99° polarization, which leaves little work for the carbon to do. A special room, containing mixing vats to prevent the carbon from blowing all over the place, often has to be installed. Special filters, or a system of double filtration, are required, and a filtering medium like "Filter-Cel" probably has to be used. Vats have to be installed to treat the carbon chemically after use and after reburning. An expensive kiln is needed to revivify the carbon, which would require expert attention.

It is possible, in the future, that vegetable carbon will be so much cheaper, that the cost can be neglected even if the carbon is used only once and then thrown away.

A rough comparison of the chemical costs of this modification of Bach's process and a straight vegetable carbon process is interesting, taking the carbon used in this modification as a basis. These cost figures are stated in terms of dollars per ton of white sugar made.

BACH PROCESS.	$	VEGETABLE CARBON PROCESS	
25 lbs lime	0.16	1 per cent. carbon..	$4.00
12 lbs. sulphur	0.39		
3 lbs. phosphoric acid . ..	0.60		
0·5 per cent. carbon (roughly)	2.00		
	$3.15		

With sugar washed up to 99° the cost of the carbon used would amount to $1.00 per ton of white sugar made.

In the past, several chemists have been under the impression that vegetable carbons are useless where mineral acids are present. This is not so. On the contrary, most of the vegetable carbons experimented with by the writer function better when mineral acids (e.g. sulphurous) are present, allowing for the bleaching effect due to the acid acting on the pigments which are of indicator nature.

The Bach Process, *pur et simple*, will produce a white sugar comparable with American Standard Granulated if the raw sugar treated is washed up to 99° polarization ; but not equal in colour to Czecho-Slovakian "R.P.N." grade.

In cane factories having a refinery attached, it is not practicable as a rule to purge raw sugar beyond 98° polarization, as it places too great a load of rich syrups on the cane factory.

The Petree Process in the Philippine Islands.

By PETREE & DORR ENGINEERS, INC.

The results obtained in the two Philippine sugar factories which operated the Petree process during last season, have given rise to discussion among Philippine technologists, the commentaries of several of which have been embodied in reports read at the 1924 meeting of the Philippine Sugar Association published in the proceedings.[1]

It is to be expected that any new process in an industry so well established as that of cane sugar manufacture should be the subject of considerable discussion as to its economic advantages; and that the searchlight of technical investigation should be placed upon the claims made, and the methods of arriving at them. Often, arguments against or in favour of a new method of work or a new type of machine are based upon inconclusive tests or insufficient data. Accurate and complete data, particularly in cane sugar manufacture, are difficult to obtain. The industry would greatly benefit if this difficulty could be overcome.

The use of the Petree process has grown from one factory to more than sixty in a comparatively short time. In five crops the use of the Dorr clarifiers in Cuba alone has reached a point where one-fourth of the 4,000,000-ton sugar crop is made in factories using them. When a process or apparatus has stood the test for a period of years in a large number of factories operating under the varying conditions found in cane-growing countries spread around the earth's tropical zone, it is logical to assume that there is something solid at the back of its claims to attention.

We recognize the difficulty of arriving at any conclusive decision as to the merits of the Petree process from the results obtained at a single factory. Still more so is it impossible for any individual to make a decision as to its merits where that individual has had no first-hand experience in its working. But, granting all this, there are means at hand of checking up the general results when the data for a number of factories are available for a period of years. We cannot assume that the numerous technical men, who vouch for the economies brought about, have not satisfied themselves on all points relating to control.

In the published reports of the proceedings of the Philippine Sugar Association for 1924, there are two sections which refer to the Petree process. The first deals with boiling-house results and the second with the subject of mill extraction.

In the article presented by Mr. G. H. HALDÉN,[2] the comments on the Petree-Dorr process are principally concerned with the question of how much decomposition of sucrose takes place in the defecation of cane juices. Mr. HALDÉN was fair in mentioning before making his remarks that he was reporting and commenting without having first-hand knowledge of the Petree process.

The Experiment Station of the Hawaiian Sugar Planters' Association conducted experiments along this line in 1923 and found that in juice limed to neutrality to phenolphthalein, heated to 100° C., and maintained at that temperature for four hours, there was practically no loss in sucrose.

The above-mentioned results obtained by the Hawaiian Experiment Station have recently been corroborated by a very interesting series of experiments made in the laboratories of the United States Bureau of Chemistry in Washington by C. F. WALTON, Jr., M. A. MCCALIP, and W. F. HORNBERGER. The experiments prove that juice of approximately 80° purity, acidity 0 to 0·45 c.c. N/1 alkali per

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[1] *I.S.J.*, 1924, 651.

[2] *I.S.J.*, 1925, 44.

100 c.c., and pH from 6.5 to 8·25, showed a loss of only 0.04 to 0.18 per cent. of the sucrose contained therein after four hours' heating.

Messrs. WALTON, McCALIP and HORNBERGER's work carries the stamp of the extreme care and accuracy which is bestowed upon all research work carried out in the laboratories of the U. S. Bureau of Chemistry.

Dr. H. C. PRINSEN GEERLIGS, who has quite recently studied the Petree process in Cuba, concludes his report on clarified juice control as follows:—

> "Our opinion is that in the daily routine of the Petree process the weight and the sucrose content of the clarified juice may safely be used as a basis for the calculation of the sucrose extracted and introduced, provided that the process is well conducted."

We will give in the following paragraphs some particulars of a typical house design, in order to explain some difficulties which have originated for Mr. HALDEN by reason of lack of experience, and to correct any erroneous impressions for the reader of those published articles, who may not have had actual experience with the Petree process or even an opportunity of seeing our apparatus. This will afford each individual an opportunity to make comparisons with the existing machinery in factories with which he is personally acquainted.

Assuming that we are to arrange the Petree process for a factory to handle the juice resulting from a uniform grinding rate of 1250 tons of cane per 24 hours, this house is to have all the functions of the usual raw sugar factory except that it will operate without the use of liming tanks, open defecators, mud settling tanks, filter-presses, or any of the numerous accessories for carrying on the routine work when filter-presses are used.

For such a Petree process house we would install one primary Dorr clarifier for the rich juices which are made up of the crusher and first mill raw juice to which has been added the previously clarified secondary juice, and one smaller secondary Dorr clarifier for the preliminary clarification of the lower purity artificial juice which results from the maceration of the bagasse at the later and heavier crushings. The primary unit would be 18 ft. in diam. and have three standard compartments, its total juice capacity being 20,000 (U. S.) gallons.

At 100 per cent. dilute juice extraction on the weight of cane, this house will produce from 200 to 210 gallons of juice per min. The primary juice will pass through its clarifier in from 95 to 100 mins. and be delivered to the evaporators in a continuous clean stream. This primary clarification period actually offers a slight gain over the usual defecation cycle, but such gain is not of any practical importance.

The secondary unit would be 14 ft. in diam. and have three standard compartments with a juice capacity of 12,000 gallons. With maceration water sufficient to yield 100 per cent. dilute juice on weight of cane the feed for the second clarifier would be produced at the rate of about 80 gallons per min. This secondary juice, to which has been added the primary mud, is discharged in clarified form approximately 2½ hours after entering the clarifier. The dilute special mud which is withdrawn continuously from the secondary clarifier is spread upon the bagasse, and arrives at the furnaces in its exhausted condition about 5 mins. after leaving the sterilizing temperature of the clarifier.

It will be seen that this secondary cycle is to be compared with ordinary defecator and mud-pressing practice, which latter must take into consideration the time of filling mud tanks from defecators, time for reheating and diluted mud with or without additional lime, time for second settling and decantation of juice from this mud, time of storage in the filter-press supply tank, and finally, time occupied in building up the cake in the filter-press, which usually is approximately three hours. Defecation houses using filter-presses and producing superior raw sugars send their mud-tank decantation together with their press filtrates through the defecation cycle a second time. This is comparable to Petree process work in which the clarified secondary juice passes into the primary system.

The manufacturing advantages in the secondary clarification of the Petree process are even more striking than those of the primary. Many technical men in the sugar industry, who have had experience with the Petree process, and opportunity to compare the results with previous work at numerous factories, state that the more rapid and sanitary manner in which the low products are handled under Petree process conditions is a source of considerable sugar saving as compared with the conditions when using old-type defecators and mud-presses.

To the comments of Mr. E. T. WESTLY, Chairman of the Committee in charge of the annual synopsis of mill data, whose remarks are somewhat similar to those to which we have already replied, the following information is specifically directed.

In the earlier part of this letter we quoted the best authorities for the statement that the loss of sugar by inversion is negligible from a practical point of view, i.e., that this loss is too small to be detected by the customary factory laboratory methods. A further indication of this we find in the relation between the sucrose per cent. first mill juice and the sucrose per cent. cane. As the latter figure is based on the sucrose in juice and the sucrose in the bagasse, the relation will under similar milling conditions remain practically constant, unless sugar is added or taken away from the juice, and any appreciable loss during clarification would result in the lowering of this quotient, which is known in Hawaii as the Java ratio, due to the fact that it was first applied in Java. The average for the five factories, which had records of this ratio previous to the installation of the Petree process, is 80·40 for the year preceding and 80·65 for the first years operating the Petree process.

In Queensland, where the process was first used, the regulations drawn up by the Cane Prices Board appointed by the Government require that the sucrose in cane be determined by direct analysis of the cane supplied to the mill. The Cane Prices Board also defines the number of samples to be taken to ensure that such sampling is truly representative of the quantity of sucrose entering the factory. Upon this determination the grower is paid and the house control is based. The Petree process showed increased recoveries under this control comparable to those now being made, when it is considered that we now have improved apparatus especially designed for Petree process requirements.

There are many figures in any analysis of the work done by a modern sugar factory which are not dependent on the general method of control adopted. These figures can be used as a guide to the practical man in his consideration of the subject.

Take, for example, a comparison of the results at Talisay-Silay prepared by the superintendent of fabrication, Mr. F. T. ROSADO, for the three years prior to the installation of the Petree process and the one complete season that this process has operated :—

	MUD PROCESS.			PETREE PROCESS.
	1920-21	1921-22.	1922-23.	1923-24.
Extraction, per cent. sucrose in cane.	92·37	93·90	93·47	93·67
Efficiency, boiling house	—	96·83	95·93	97·23
Loss in molasses	7·29	7·01	5·34	5·19
Apparent purity mixed juice	82·90	86·00	86·76	85·98
Loss in press cake	0·66	0·37	0·56	none
Undetermined loss	0·80	0·95	0·85	0·21
Recovery	83·59	85·57	86·72	88·27

The above figures are entirely in favour of the Petree process. Let us take another set of figures which are independent of where and how the juice is weighed, and which confirm the above conclusion of improvement:—

	Mud Presses			Petree Process.
	1920 21.	1921-22.	1922-23	1923-24.
Tons cane ground per hour	38·70	41·23	45·69	52·21
Tonnage-fibre ratio	16 21	15 54	18·26	19 31
Per cent sucrose in bagasse polarization	4·22	3·90	3·95	3·88
Dilution, per cent normal juice	10·20	20·92	21·12	15 37
Brix of crusher juice	20·00	19 80	19·65	20 10
Polarization of crusher juice	17·10	17·51	17 44	17 46
Purity of crusher juice	85·50	88·20	88 76	86·86
Tons cane per ton of sugar	8 21	7 75	7·69	7 65
Mixed juice purity	82·90	86·00	86·76	85·98
Per cent. sucrose in final molasses	35 74	34 60	32·46	32·19
Gallons final molasses, per ton of sugar	—	40 45	32·42	27·10
Sucrose in press cake, per cent. sucrose in cane	0·66	0·37	0·56	none

There are other figures for savings, also unaffected by whether the juice is weighed before or after clarification, that are of considerable importance to the mill owner, although not of equal appeal to those connected with the scientific side of sugar manufacture. We refer to the units of labour employed per ton of sugar made, the cost of press-cloth and replaced filter-press plates, press maintenance, and the savings made in fuel.

Mr. William Wyllie mentions as his one objection to the Petree process a reduced mill extraction. We must assume that he referred to the drop in the mill extraction at San Carlos from 97 05 per cent. in 1923 to 96·18 per cent. in 1924. In arriving at his conclusion, he must have overlooked the fact that in 1923 the tonnage of cane ground per hour and the tonnage-fibre ratio were much lower, while the dilution was 50 per cent. higher than in 1924. Any engineer or chemist accustomed to interpret sugar factory data will, on scrutinizing the following table of San Carlos data, find that the mill efficiency in 1924 was considerably higher than in 1923 in spite of the 0 87 per cent. difference in mill extraction:—

Year.	Tons Cane per hour	Per cent Fibre in Cane	Tonnage Fibre ratio	Sucrose in Cane Polarization.	Dilution per cent normal Juice	Bagasse per cent Polarization	Sucrose Extn Sugar Cane	Process in use
1921-22	55·62	11·14	17·60	15·01	18·37	4·41	92 87	Presses
1922-23	40·83	12·08	14·01	15·58	30 89	2 09	97 05	Presses
1923-24	49·42	13·47	19·50	15·68	20·58	2·25	96·18	Petree process

An examination of the comparative reports dated May 24th, 1924, for 16 factories in the Philippine Islands, shows that San Carlos (the only other Philippine central using the Petree process and also for the first year) secured the highest extraction, 96·18 per cent., although there were other factories equally well equipped as regards the number of mills in the train.

The installation of Peck strainers at Talisay-Silay is a step in the direction of improved work. The more complete the removal of the fine bagacillo from the juice before the latter is limed and heated, the better will be the results obtained in the working of the after-products. But the fact must not be overlooked that any screened solids whatsoever must be returned to the bagasse. In many factories the whole of the strained bagacillo and cush-cush is returned to the milling circuit after having been dragged over the juice screen through the rich juice flowing from the crusher and first mills. In the Petree process the fibre portion of the mud is diffused in the secondary clarifier in a juice of approximately the same density as the second-mill juice. In other words, the Petree process runs parallel to modern practice in sugar cane milling, and is entirely rational in its conception.

The other Philippine factory operating the Petree process, Talisay-Silay, showed a direct gain in mill extraction of 0·20 per cent. in favour of 1924, in spite of the fact that the hourly crushing rate was 25 per cent. higher, that the tonnage-fibre ratio rose from 18·26 to 19·31, and that the dilution was approximately 25 per cent. lower.

Stabilizing the Australian Sugar Industry.

Resisting American Control.

By T. D. CHATAWAY.

It is a somewhat remarkable fact that the danger threatening the Australian industry is no longer the difficulty of getting white labour to work in the tropics so much as the difficulty of finding a market which is not subjected to severe fluctuations as the result of the control and speculations of the great Sugar Entente, to which reference was made in the *International Sugar Journal* of last November. In announcing the decision of the Commonwealth Government to continue an embargo on the importation of sugar for three years after the end of next August, Mr. BRUCE, the Prime Minister, has pointed out that within the last twelve months sugar has fluctuated in price by as much as £12 a ton. It was perhaps a coincidence, but only a few days before the decision of the Government was announced it so happened that the price of granulated in London rose £6 a ton, only to fall within a week back to its previous figure. Mr. BRUCE said:—"The experience of the last 18 months had shown clearly that a tariff duty, while effective in regard to products which maintained a uniformly normal price, was not capable of scientific accuracy when applied to sugar, which fluctuated to an extent which rendered the duty at times abortive. In these circumstances, the difficulty of propounding a permanent policy suitable alike to sugar producers and consumers would be readily appreciated." Leaving the sugar producers to face the consequences of over-production, and losses incurred in selling their surplus abroad, the Government proposes to ask Parliament to legalize the embargo with the following conditions as to prices to the consumers attached:—

	Per lb	Per Ton.			
	d.	£	s.	d.	REMARKS
A.—REFINED SUGAR—					
(1) Retail price	4½	42	0	0	Same as at present.
(2) Retailers and housewives' price for not less than ½ ton lots for net cash	4	37	6	8	4s. 8d. reduction on present price.
(3) Net wholesale, and manufacturing price for products other than fruit for home consumption		36	11	9	Decrease of 8s. 3d. for manufacturers of beer, biscuits, cakes, confectionery, cordials, jelly, condiments, jelly crystals, tanners, druggists, etc.

	Per lb.	Per Ton.			
	d.	£	s.	d.	REMARKS.
(4) Manufacturing price for processing fruit products for home consumption for net cash	3¼	30	6	8	New advantage of £5 6s. 4d. in addition to special concession of £1 7s. already given; total £6 13s. 4d.
B.—MILL WHITE SUGAR (equal to Java Whites)					
(1) Retail Price	4	37	6	8	New advantage.
(2) Retailers and housewives price for not less than ½ ton lots for net cash for definite orders at reasonable notice, about	3½	33	3	9	New advantage.
(3) Wholesale and manufacturing price for home consumption for definite orders at reasonable notice for net cash ..		32	10	6	New advantage.
C.—STOCK REBATE FRUIT PRODUCTS. Manufacturers of fruit products to be granted a rebate on the sugar contents of their stocks held when the price of sugar is reduced to them to £30 6s. 8d., providing satisfactory proof is given that the selling prices have been correspondingly reduced.					This will enable full quantities of fruit to be processed this season, and the rebate will be passed on to the public.
D.—EXPORT PRICE. Sugar for all exported manufactures to be supplied at the Australian bond equivalent of the world's parity, calculated and determined in Melbourne by an export sugar committee, composed of: (*a*) One representative of Commonwealth Government; (*b*) One representative of sugar industry; (*c*) One representative of manufacturing exporters.					The export price will vary as world's parity moves up or down.
E.—UNIFORM AUSTRALIAN PRICES. All sugar to be supplied at the same price in the main distributing centres in each State (means Sydney, Melbourne, Brisbane, Adelaide, Perth, Hobart, and Launceston).					Same principle as at present but Perth substituted for Freemantle.
F.—EXPORT LOSSES. Sugar industry to be responsible for any loss arising from surplus sugar exports.					

There are of course many who still hold with the old idea that in times of abundance prices to the consumer should fall to what Sir LEO CHIOZZA-MONEY recently called "starvation rates," and to these people the mere suggestion of an embargo is anathema. They assume that sugar prices must fall, an assumption which quite ignores the tendency of all products over which the Americans have control to maintain a market value only low enough to prevent the checking of consumption. It is true that during the war, and immediately after, the embargo upon sugar export from Australia resulted in the people of the Commonwealth being served at a lower rate than in any other country of the world, and it is quite possible that with an embargo upon the importation of sugar the conditions imposed by the Government may before long have a very similar effect as to consumption rates in Australia. Unexpected approval of the embargo has come from Sir HENRY JONES, the head of the great jam-making corporation. He claims that it is better than any tariff protection, and the concession to the jam makers of an additional £5 6s. 4d. a ton leads him to bestow his blessing with the remark that Mr. BRUCE has solved a very difficult problem with ability. Other jam manufacturers and canners are not satisfied. They never will be as long as there are agents of the American entente to assure them that were it not for the embargo they could be supplied with sugar for £10 a ton less than at present. That it would not be the same quality of sugar goes without saying, and from the above schedule it is clear that the Government has no intention of making the manufacture of inferior jams an easy matter, one that would possibly create dividends temporarily but would destroy the prospects of a healthy export trade. A side-issue in the criticism is that of the newspaper correspondent, who writes to say that he has been in the North, has seen everything in the thousand-mile length of coast line, and is convinced that the sugar producers are unreasonably prosperous. He is just one of a thousand writers to the newspapers. One I have noticed declares that sugar lands are changing hands at £100 an acre, while maize lands are obtainable for £15 an acre. He quoted the localities, but makes no reference to the fact that whereas one lies on the level of the sea, the other lies 3000 ft. higher up. But the answer to this has been given in the judgment of a Supreme Court judge Mr. Justice DOUGLAS, who devoted considerable attention to the matter, and showed that the foreign element, chiefly Italians, coming into the country were gambling in crops, buying and selling a crop of sugar cane several times over, and doing, indeed, very much what the Australian speculators did during the war when they bought, sold, and re-bought cattle on the hoof to the city markets. Said His Honour, "The income tax returns are sufficient answer. They show that if a few cane-farmers are making good money the great majority of the 5000 are earning but a bare living." There will possibly be an enlivenment of the controversy about the embargo, especially when the time draws near for Parliament to deal with the matter, but for the moment the sugar producers believe that they are on what is called a safe wicket. Indeed, they are rather disposed to discuss the concessions made to consumers, and ask themselves whether they are not paying too highly for the embargo by accepting the limitation of prices above which they cannot go. They are certainly binding themselves to accept no more for their sugar in Australia than the figures laid down by Mr. BRUCE, but it remains to be seen whether the embargo on importations is also to include that on exportation, should the latter prove the more attractive.

CELOTEX AND POWER ALCOHOL.

The independence of the sugar industry, due largely to the embargo on importations, may possibly be in some way accountable for the fact that the Australian growers have demanded of the American Celotex manufacturers that they should have a substantial share in the business of making lumber from bagasse. According to the local press reports one of the American visitors stated that the Celotex factory would be able to pay 10s. a ton for bagasse, while it was incidentally mentioned at the same gathering that a ton of bagasse would make a product which in America would sell for 40 dollars, or, say, £8. That Australia should sell her bagasse for 10s. a ton, having to replace it by some other fuel, little if any cheaper, naturally raised the co-partnership suggestion. The difficulty of getting concerted action amongst the 5000 small growers who constitute the Australian industry was alluded to by me a few weeks ago. There is now developing the all-important question of the distillation of power alcohol. It is alleged that if all the molasses, waste cane-tops, and surplus cane were handled for alcohol production, the resultant spirit would supply 33 per cent. of the whole of Australia's requirements as represented by petrol. The Australian industry seems to be steadily developing along the lines with which readers of my Notes must be familiar. Power alcohol obtained from the at present wasted molasses will make motor traction in the field commonplace, put the horse and all its attendant expenses on the retired list, and greatly reduce the cost of field production—a reduction which was impossible while every gallon of petrol had to be imported from abroad. Obviously if the next year or two had to be spent in combating the United States sugar entente, even in Australia's own market, the adjustment of the industry under white labour and modern conditions would be impossible. But the production of power alcohol is not intended to be confined to the utilization of molasses only. Mr. A. BAIRD has been giving evidence before the Joint Federal Accounts Committee, and he propounded a scheme which he said was approved by the State Government. In the course of his evidence he stated that he represented the International Sugar and Alcohol Company of London, which was a special company established by the Distillers Company, Ltd., of Edinburgh. It sought to produce power alcohol throughout the Empire, and, from his remarks, was obviously looking to the Queensland tropics to produce such crops as cassava, sweet potatoes and arrowroot as the means of utilizing the sugar mills during at least one half of the year. It may be noted that there is no serious proposal yet afoot that the cane should be brought into the millyard untopped, and the tops then used for the production of spirit. Incidentally, it is thought in many quarters that the non-topping of the cane will greatly simplify the problem of cane harvesting by machinery and that what to-day costs 7s. 6d. a ton of cane might well be reduced to 1s., a saving equal to £3 per ton of sugar, to say nothing of the additional earnings made from the cane tops, usually abandoned and left to dry up or rot in the fields. The quantity brought in for horse feed is beneath consideration.

WHAT OF THE FUTURE?

The foregoing only attempts to hint what is in the brains of the leaders of the Australian sugar industry. There has been amongst them a difference of opinion as to whether the chief competition of the future is to be expected from the recovery of the European sugar industry, or from the machinations of what the writer in the *Times* so happily calls the United States sugar entente. It is now clear that the American financial interests are determined if possible to control the whole of the sugar production of the world, very much to the same extent that they control the oil supplies. The danger of this was put before the Prime Minister, Mr. BRUCE, and we cannot doubt that it was this which largely influenced him in giving the Australian industry every opportunity to expand and so help in the development of Empire sugar. The determination of the people in

North Queensland to develop their industry is quite a remarkable feature. They ask to grow sugar cane; they are told that they do it at their own risk; that there is not crushing power available to deal with it; yet they extend their plantations, agitate for more mills, and suggest that if their cane cannot be profitably bought for £2 10s. 0d. a ton for the manufacture of sugar, it is at least worth £2 a ton for the manufacture of power alcohol. I rub this in because it is a useful answer to those who say the white man cannot populate the tropics, and, if I may be permitted to say so, a confirmation of my remarks a year or so ago that in the tropics the white man will follow the vegetable, and not expect the latter to thrive in the climate most agreeable to himself. The white cane-grower is making increasing additions to his holdings and his culture. His limit will only be reached when he begins to employ large numbers of labourers. Then he will be reverting to the old plantation system, which killed itself. Further, the industry is now practically co-operative from the small farmer to the refiner. Its business is controlled by what may be called a co-operative board, whose sole purpose is to maintain sugar production at a profitable level, and the Australian sugar market at a legitimate charge upon the consumers.

THE PAST SEASON.

With a promptitude which is as useful as it is sensible, Mr. H. T. EASTERBY, Director of Sugar Experimental Stations, has issued his annual report which contains the results of the past season's operations, though in actual fact they were not fully completed at the time the report was signed. Australian production of sugar this last year is calculated as follows:—

	TONS
Queensland	386,000
New South Wales	28,000
Victoria (beet)	3,500
Total	417,500

But the above estimate was made last October, and there is reason to think that it has since been exceeded. Already as compared with 1918 the area under cane in Queensland is estimated to have increased by 60,000 acres, and for this coming year of 1925 Mr. EASTERBY estimates a still further increase. Mr. EASTERBY also points out that whereas, in 1913, seven mills above Townsville produced 62,414 tons of sugar, and 41 mills below Townsville produced 180,423 tons of sugar, last year the figures were:—

	NO OF MILLS.	TONS OF SUGAR
Above Townsville	9	180,000
Below Townsville	29	208,000

Of course above Townsville means the strictly tropical portion of Queensland. How considerable has been the improvement in the mill capacities, especially above Townsville, is shown by the fact that the average of the nine northern mills is estimated at 20,000 tons of sugar each, whereas for the 29 southern mills the average is below 8000. Work upon the new mill on the Tully river is being pushed forward rapidly and it is expected to be in operation some time towards the end of this year, but already there is more cane in sight than can be dealt with, all of which gives emphasis to the urgency of the problem of what we are to do both with our surplus cane as well as our surplus sugar. The Prime Minister has called upon the Bureau of Science and Industry to report upon some of the proposed schemes, such as are briefly mentioned above.

Some Notes on Cane Variety Work in Tucumán, Argentina.

By WILLIAM E. CROSS, Ph.D.
Director, Agricultural Experiment Station, Tucuman.

Up to a few years ago the only varieties of cane cultivated in Tucumán were the purple and striped "native" canes, identical with those of Louisiana and other American countries. The white sport of this variety was never cultivated extensively, as it was considered decidedly inferior in yields and especially in the number of years it could be cultivated without replanting. Excellent results were obtained from the "native" canes for many years, but around 1890 the opinion began to be rather common that yields were no longer what they had been in the past, and a number of the factories from time to time introduced other varieties from other countries for trial. Some of these canes were rather successful for a time, and came to be planted in extensions of several hectares; for example, the D 74, and the Barbados 208, were highly considered by certain planters, although as the slow degeneration of the "native" canes went on, it was increasingly felt that neither these nor any other of the canes imported up to that time were of sufficient merit to restore the high yields of former times. It is interesting to note that the planters were convinced that their trouble lay in the variety, although of course they did not know that this was because of the susceptibility of their cane to the mosaic disease, already present in their cane fields. They had arrived at this conviction by exhausting, at least according to their ideas, the other methods of improving the yields obtained, i.e., by better cultivation, the use of fertilizers, adequate irrigation, etc., without any pronounced success; concluding therefore that the variety was in some way degenerate, and would have to be replaced by some other more vigorous cane. It was due to this situation that the Experiment Station was projected in 1907, and finally inaugurated in 1909.

Before the inauguration of this institution, however, in 1907 a large and interesting collection of varieties was obtained by the National School of Agriculture in Tucumán, from a similar institution in Campinas, Brazil. This collection, consisting of nearly 200 kinds of cane, included most of the old standard varieties, and of course many duplicate varieties under different names. The canes were all planted by the National School, and cultivated under careful observation.

When Kobus was asked to come and found the Experiment Station, he was asked also to bring with him some of the seedling varieties produced by him in Java, which at that time were exciting much attention in the cane world, and while he did not come to the Argentine, he did send a valuable collection of canes, consisting of the POJ varieties Nos. 36, 100, 139, 213, 228, and 234, obtained by him by crossing the Cheribon with resistant canes of the north Indian type. As no grounds had been obtained for the projected experiment station when these canes arrived, they were planted in the garden of one of the *ingenios*, under careful supervision.

Mr. R. E. Blouin was finally appointed director of the new Experiment Station, and he initiated his work by planting a very large number of varieties, including practically a complete collection of those at that time in the experiment station in Louisiana (of which Mr. Blouin had previously been the director), the Java varieties sent by Kobus, and the Campinas collection obtained from the National School above-mentioned.

Probably because of the presence of the mosaic disease in the province already at that time, very few of these varieties showed promise of being much better than the purple and striped kinds. Some of them gave good results for a time, only to degenerate later, or to turn out to be canes which could not be carried to more than one or two years stubble, not enough in this country where we are accustomed to the cane lasting six or eight years after once planting. The Java POJ 100 is an example of this: as plant cane and as first year stubble it gave excellent results only to degenerate as second year stubble and peter out altogether in the third year. Of the Campinas collection, none gave permanently good results excepting three canes of the so-called Japanese type, the Kavangire, the Sin Nombre 54, and the Bambú de Tabandí, which by the way were later shown by Mr. G. L. FAWCETT to be one and the same variety. Of the Louisiana canes, only the Zwinga gave any promise of being of any permanent value. The Java collection, although it consisted of only six varieties, proved the most valuable by far, as it yielded four canes which gave excellent results under the Tucumán conditions. The POJ 100 degenerated as we have stated, and the POJ 139, in strange contrast to the rest of these varieties, proved to be an extremely weak cane, perhaps the least promising of all the varieties tried out. The POJ 36 and the POJ 213 on the other hand gave results that were really suprisingly good, and the POJ 234 and the POJ 228 were also so far superior to the native canes as to cause them to be considered as very promising.

The promising canes indicated were submitted to the most exhaustive tests by the Experiment Station. The canes of the Japanese type had to be discarded for sugar making purposes, as in spite of their phenomenal production of cane per acre, and their notable resistance to diseases and adverse conditions, they turned out to be very late in maturing in an average year, as also very expensive to harvest owing to the habit of the leaf sheath in adhering to the stalk when the cane is ripe, and also to the very large number of stalks that have to be cut and stripped to make a ton of cane. Seeing that these canes are immune to the mosaic disease, however, we have advised the planters to cultivate the best of them, the Kavangire, on a small scale, as it could be used in an emergency in case this disease were to attack the current varieties in a more virulent form. The POJ 234 could not be recommended except in a limited way, as although it is decidedly the sweetest of the Java varieties we experimented with at that time, and matures very early, its production per acre is much inferior to that of the best Java canes. It is also rather susceptible to top-rot in the "plant" year. Neither could the POJ 228 receive a general recommendation, as it is late in maturing, and not very resistant to frost. The POJ 36 and 213 on the other hand turned out to be excellent canes from every point of view. They produced very high yields of cane per acre—more than double those of the " native " canes—and were of satisfactory sugar content, the POJ 213 being early maturing. They were also resistant to diseases—including the mosaic disease—and to adverse conditions in general, and were hardly attacked at all by the cane borer, a very serious pest with the purple and striped varieties. They were canes which could be carried to many years of stubble with satisfactory results, neither the standing cane, nor the stubbles after cutting, suffering appreciably from any but the most intense frosts. Their fibre content was higher than that of the "native" canes, which fact promised a considerable reduction in the consumption of wood in the factories, if this additional fuel had to be used at all with these canes. The Experiment Station was thus able to recommend these canes most unreservedly to the planters, and in 1916 and 1917 the industry decided to adopt them in the place of the then extremely degenerate purple and striped varieties.

Some Notes on Cane Variety Work in Tucumán, Argentina.

The years 1917 to 1919 were trial years for the Java canes, which were planted to the entire exclusion of the native varieties, and it is satisfactory to note that the conclusions of the Experiment Station regarding them were confirmed in every way by the results obtained on an industrial scale. The cane was in most excellent condition for the harvest of 1918, but it was partially destroyed by unprecedented frosts in July of that year. The next year, 1919, on the other hand, brought a mild winter, and the Java cane had the chance to show its worth. It gave a very large harvest of cane and sugar, the field results throughout the whole province averaging nearly 22 tons per acre—a very high result for Tucuman conditions. In that year the Java canes POJ 36 and 213 justified themselves as the standard varieties for Tucumán, and they have been planted almost exclusively ever since.

The Station's conclusions regarding the POJ 228 and 234 were also confirmed on the large scale. Fairly large plantings of these canes were made at first, for several reasons. In the first place there was a scarcity of the POJ 36 and 213 canes in face of the enormous plantings which were being made, and "seed" of these varieties attained very high prices, and in the second many planters wished to try these varieties on a large scale because of the early maturing, and high purity of the POJ 234 (thus promising to be useful to begin the harvest with every year), and of the fine appearance and thick stalks of the POJ 228. The POJ 234 maintained its reputation for high purity, but being cut every year at the beginning of the crop the stubbles suffered the consequent deterioration, as do all canes, and gave poor results after the first three years' ratoons. Because of this fact, and that of its lesser yields of cane per acre in comparison with the POJ 36 and 213 it was largely given up in favour of the better varieties. The planting of the POJ 228 was also abandoned owing to its slight resistance to frost.

The notable success of the new Java varieties in Tucuman did not have the effect of making the planters satisfied with this achievement, on the contrary, the fact that it had been shown so conclusively that one variety could be so much better than another made them realize the possibilities of this kind of research work, and made them dream of another variety yet to be found which should be as superior to the Java canes, as these were to the native varieties. From then on they thus showed the greatest interest in the work of the Experiment Station, and the greatest willingness to try out in co-operative experiments any varieties which we think sufficiently promising for such trials. Some enterprising planters even imported varieties from abroad, complying with the extremely strict inspection and quarantine regulations which exist not only in the port of Buenos Aires, but also on entering the province of Tucuman, where the supervision is in charge of the Experiment Station itself, which does all that is humanly possible to prevent the admission of diseased specimens. Unfortunately, however there is no provincial quarantine in the other sugar provinces of the republic (happily situated at a considerable distance from Tucuman) we have to be constantly on the alert for the appearance of new diseases in those provinces, in which case we should establish a strict quarantine against them.

Of course, the very excellence of the Java varieties mentioned under our conditions makes the obtaining of still better canes a very difficult task. Still, we aim at getting a variety of still greater production per acre than these, and especially of higher sugar yield per ton. We also hope for still greater frost resistance, and also for a cane which will not have to be milled so quickly after cutting if deterioration is to be avoided as is the case with the Java canes. The ideal cane for the industry, too, would not be so affected by the deterioration of the stubbles during the winter after early cutting as are all the canes we know thus far. And finally it would have to be highly resistant, or better, actually immune to the mosaic disease, whose property of suddenly becoming highly virulent under conditions as yet little studied reduces the stability of any industry based upon non-immune varieties.

The variety work of the Experiment Station after the recommendation of the new Java canes has been carried out on the basis of seedlings produced in Tucumán, and varieties of cane imported from abroad. While attempts were made to produce seedlings from the first years of the station's existence, the first seedlings actually produced were obtained in 1917 by Mr. G. L. FAWCETT, in whose hands this work has been ever since, and who has now produced several hundred of these varieties. Of these, those produced in the earlier years have shown little promise, but some three years ago we obtained from seed of tropical canes crossed with northern Indian types a number of varieties of much interest, some being apparently immune to the mosaic disease as well as canes of high yield and satisfactory sugar production. It is as yet too early, however, to arrive at conclusions respecting the value of these varieties, which are being most closely studied year after year so that their respective merits can be well established. We may say, however, that we have some ten of these canes which we regard as extremely promising.

The imported canes we may divide into groups according to their origin, mentioning here only the most important.

The POJ 105 was introduced from Egypt by one of the factories around 1913. It appeared to be very promising at first, and it is said that fancy prices were paid by some of the planters for a few stalks of this variety. The first results seemed to show that it was of high production per acre, and of exceptionally early maturity. The careful experiments carried out by the Experiment Station, however, during a number of years indicated that while it is quite a good cane it is inferior to the POJ 36 and 213 respecting both its yield per acre and its sugar content at any date in the year.

The D 1135 was also a cane which we regarded as promising for some time. Introduced from Hawaii with the reputation of being considerably resistant to the mosaic disease it gave good yields at first, but eventually became much stricken with mosaic and somewhat degenerate on that account.

The Yon Tan San is an interesting cane imported directly from Japan. It is of the same type as the Kavangire, with which it shares immunity to the mosaic disease and a great resistance of its stubbles to fungous attacks, but it is better than that cane in the sense that it is not so extremely fibrous and hard to mill, and is a stouter cane, not so difficult to strip in the harvest. Under our conditions, however, while it has given enormous yields of cane per acre, it is not so rich in sugar as the Kavangire, and is even later in maturing.

In 1919 we imported some 20 varieties of cane from Peru, of which the Ignorada, Standard, Violeta de San Augustin, and Peru 15 were the only ones which gave reasonably good results even in the beginning. These have succumbed to the mosaic disease in the last two or three years, and are thus without promise.

A very excellent group of canes are catalogued in the station files as Sin Nombre (i.e., Name Unknown), Nos. 229–234. They are of Java origin, and from the first have given results which showed them to be worthy of careful study. The S.N. 229 is an excellent cane, of colour and manner of growth which reminds one of the POJ 36. It gives very good yields of cane per acre and is quite rich in sugar, although rather late in maturing. Its special defect is a certain tendency to suffer from top-rot as plant cane. The cane has so many excellent qualities that we still keep it under observation as a promising variety. The S.N. 231 is also an excellent cane; in fact, perhaps it is the best of this group, giving excellent yields of cane and sugar per acre, and being notably resistant to the mosaic disease, top-rot, and to the effects of early cutting. Up to now it has given considerably better results than the POJ 36 and 213, for which reason we are continuing to study it both in the central station and in the sub-stations with great interest.

The S.N. 230 is also a very good cane, especially resistant to frosts, although it suffers somewhat from top-rot as plant cane, and is perhaps not quite so rich in sugar as the other varieties of this group we have mentioned. The S.N. 232 is a stout, green cane which has also given uniformly high yields of cane and sugar per acre, although it is not so resistant to severe frosts as the S.N. 229-231. The S.N. 233 and 234 have turned out to be inferior to the others of this group, although they are still under observation.

We may mention now an important group of canes imported directly from Java, which, while we have not yet had them long enough to be able to draw definite conclusions as to their relative value, have nevertheless given results already of considerable interest.

The Kassoer was introduced for the purpose of crossing with other varieties, but we have also studied it from the industrial point of view. It has proved to be a cane of really marvellous production per acre, but of an equally surprising poorness in sugar, as it will give as much as 70 tons per acre as the result of only eight months' growth, but the juice will only have some 6 to 8 per cent. of sucrose. We are continuing the work with this cane with the faint hope of finding some conditions under which the sugar content could be materially improved.

The Chunnee was also introduced for breeding purposes, as it is such a thin woody cane as to be of little use to the sugar industry. Yet it is interesting to note that we found its juice to be quite rich in sugar, 15 and 16 per cent. sucrose in the juice and 80 or more purity being quite commonly noted.

The more or less recently imported Java seedlings which we have now under investigation are too numerous to be even mentioned here. We tried to obtain varieties which promised to be of value under our conditions and in this connexion are extremely grateful to the authorities of the Javan experiment station in Pasoeroean for their valuable advice as to which would probably be the most suitable canes for our purpose as well as for their kindly supplying us with the canes. Seeing that the POJ 36 and 213 which have given such excellent results in this province are Chunnee hybrids, we have tried to obtain as many more as possible of these varieties, and indeed have acquired quite a large collection. The following are among the most promising:

POJ 33.—Striped Preanger crossed with Chunnee. A red cane which ratoons well in the row. Appears to produce good yields of cane and sugar per acre.

POJ 979.—Cheribon × Chunnee. A greenish cane, low in fibre. Yields well but apparently late maturing.

POJ 1334.—Produced by crossing a hybrid of POJ 100 × Chunnee with one of Cheribon × Chunnee. A greenish, thin cane, high in fibre. Yields of cane good, but doubtful if it will be rich enough in sugar.

POJ 1547.—Produced by crossing a hybrid of Cheribon × Chunnee with one of Billiton × Chunnee. A purple, rather stout cane. Has given good yields, although it appears rather susceptible to top-rot.

Another group of interesting canes is formed by those immune or almost immune to the mosaic disease, of which the most important are Tjep 24, POJ 2714 and POJ 2725. The first of these is entirely immune to the mosaic, and gives cane of satisfactory sugar content, although the yields we have obtained have been rather poor up to now. The POJ 2714 is a stout, heavy yellowish brown cane, fairly high in fibre. Up to now it has given good yields of cane and sugar per acre. It is considered almost immune to the mosaic. The POJ 2725 is the cane which has given us the best results of all of this group. Almost immune to the mosaic disease, it gives very excellent yields of cane, being of very vigorous growth, and its sugar content so far has been quite satisfactory. We now have in the country several hectares of this variety, which will permit of its being thoroughly tested out under our conditions.

Among other recent Java importations we may cite the POJ 501, which has given such excellent results that we consider it one of our promising varieties; also the POJ 369 and the 369 B.

Recently we have received a valuable collection of varieties from the Department of Agriculture in Washington, which have been planted and have germinated satisfactorily.

In conclusion, we may mention another phase of our cane variety work, which consists in growing certain canes, obtained free from the mosaic disease, under conditions where they will not acquire this malady. For even with the Java canes POJ 36 and 213, we recognise that the fact that the cane cultivated in Tucumán is all infested with the mosaic means a certain quite appreciable reduction in the yields obtained, or in other words that if we could have the Java canes we now cultivate, on a mosaic-free basis, we should obtain much better results than are now secured. We thought at one time of the possibility of gradually replanting the whole of the cane in the province with mosaic-free cane, commencing at a number of points and keeping the mosaic-free plantations surrounded by neutral zones of Kavangire cane, or alfalfa, or other suitable crop, but this we had to give up as impracticable on a large scale under our conditions. However, seeing that the effects of the mosaic disease are cumulative, that is to say they become worse every time mosaic-infested seed is used for planting, we realise that there would be a big advantage if all cane used for planting in the province could be free from the disease. For the experiment station to arrange to supply the planters with mosaic-free seed is not a difficult matter, and to this end we are planning to establish two or three isolated nurseries in different sections of the province in which to produce the necessary healthy "seed." Of course if we can discover a mosaic-immune cane which will give results as satisfactory as those obtained from the Java 36 and 213 (when mosaic-free) this work will be unnecessary, but it is our duty to be prepared for all emergencies.

SCHREBER[1] has observed that when the bulb of a thermometer is placed in the vapour from salt solution during its ebullition the instrument indicates a higher temperature than that corresponding to saturated vapour But that if gauze is interposed between boiling liquid and thermometer bulb, then the temperature is that of the saturated vapour, which agrees with Faraday's discovery that vapours from boiling liquids are saturated and have a temperature corresponding to their vapour tension. Dr. H. **CLAASSEN**[1] considers that probably these observations may be utilized for the indication of entrainment in evaporators and vacuum pans, thermometers being installed in the vapour spaces and save-alls, and their readings compared with the temperatures of saturated steam at the pressure under operation.

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[1] *Chemiker Zeitung*, 1924, **48**, 509-510.

Fowler Punt Ploughing Tackle at Work in British Guiana.

On the sugar plantations in British Guiana special machinery is essential to cope with the exceptional working conditions and shortage of agricultural labour.

All the largest sugar plantations are situated on level alluvial flats almost on the water level, and the most careful precautions have to be taken to prevent flooding and waterlogging of the cane. All fields are intersected by canals which serve the purpose of draining the land, and acting as highways and light railway system combined for the whole plantation. All transport is carried out by water, the harvesting of the cane in particular being carried out in barges each holding from 3½ to 5 tons of sugar cane.

The soil on these plantations being of a heavy nature and sodden with the very heavy rainfall, the problem of efficient cultivation is a difficult one. For ploughing 10 in. to 12 in. deep, the only possible form of direct tractor is one of the tracklaying variety, and with these the question of canal transport presents a difficulty apart from the very arduous nature of the work.

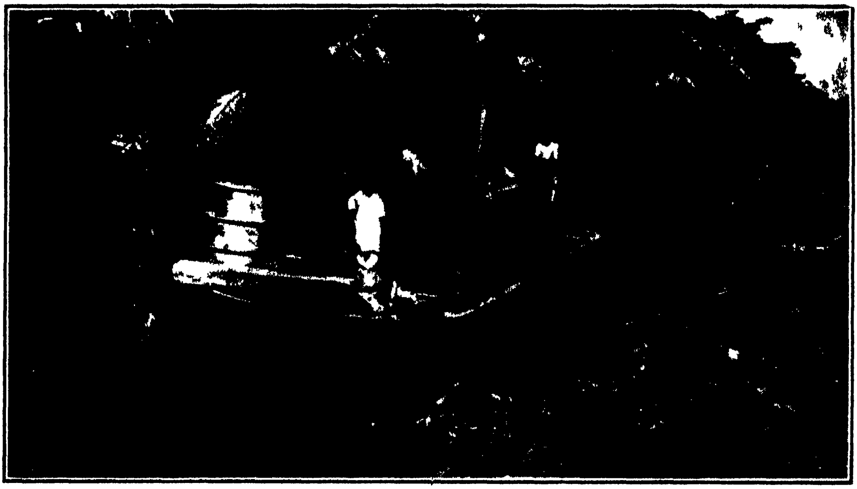
Disc-Ploughing 10 in to 12 in. deep on old Cane Land

On the "Uitvlugt" Plantation near Georgetown, Demerara, owned by Messrs. Booker, Bros. McConnell & Co., Ltd., the problem has been solved by the use of Fowler Punt Ploughing Tackle, as shown in the accompanying illustrations. This plant works on the cable system. There being two cable punts operating on each side of the cane field, and pulling the plough backwards and forwards between them.

The use of the Fowler Cable system for sugar cane cultivation is very widely known in Cuba, Hawaii and the Philippine Islands, but it is generally connected with the steam and motor ploughing engines which move about on dry land. The application of this same system to punts has, however, been successfully carried out by Messrs. Fowler on several occasions and, as early as 1880, several sets of steam punt ploughing tackle were built for cane cultivation in Louisiana and British Guiana.

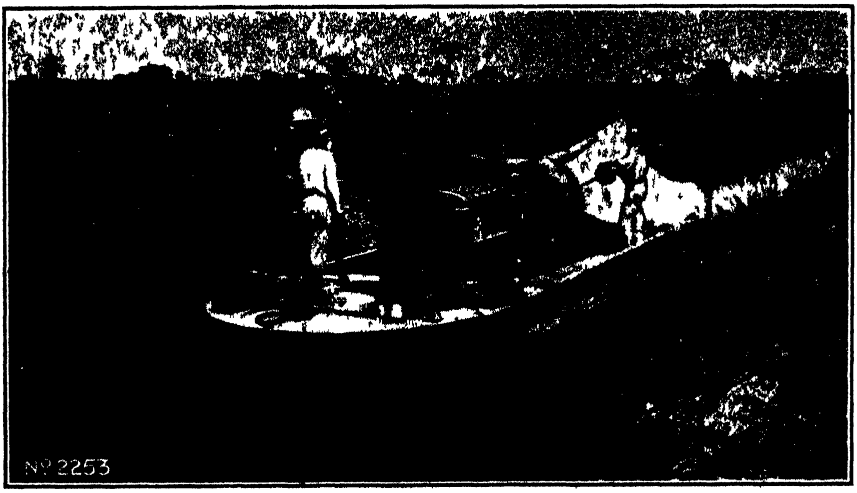
The application of the motor engine to this system however has greatly improved the handiness of the plant, as the weight can be very much reduced.

The special design of adjustable boom fitted by Messrs. Fowler allows of the use of a light punt without fear of canting over through the pull on the rope. The boom is adjustable according to the height of the bank, but once in position it is easily locked and so keeps the punt in an upright position under load.



Fowler 100 h.p Punt Engine under Working Conditions

The engines fitted, which are of 100 h.p., are arranged to burn alcohol fuel which is obtained very cheaply on the estate, being manufactured from the molasses in the Company's own distillery.



View of Punt and Canal.

The drive is of the plate clutch and two-speed totally-enclosed gear box to the vertical winding drum which carries 500 yds. of "Fowler's Special" plough steel wire rope.

The engine power is not utilized to propel the punt, but hand windlasses are fitted at each end with which the operator is able to move along the canals as the work proceeds.

Part of the punt which is not occupied by the engine is arranged to act as a bridge for transporting the plough across the canals from one cane field to another.

The plough, as may be seen from the illustrations, is a 3-furrow balance disc plough, specially designed to work on this exceptionally rough and boggy land. The standard widths of fields ploughed are 180 yds. wide, and in this distance there are 11 ditches, each 4 or 5 ft. wide, and 3 or 4 ft. deep. All these have to be negotiated by the plough in its passage across the field. With wheels of 6 ft. diam. it does not fall to the bottom of the ditches, especially owing to the arrangement of skids fitted, but it will be realized from the illustrations, which show the plough negotiating these ditches, that work has to be carried on very carefully to avoid breakdowns.

During the last season's working a full day's output was found to be five acres in eight hours' work. This in itself does not sound like a very large output; but when it is realized that owing to the construction of the plantations this involves the crossing of 1648 ditches of the dimensions given above, the amount of work necessitated will be recognized, as also the fact that this could not be attained by any other method.

Continuous versus Intermittent Clarification in the Cane Sugar Factory.

(*A*) By W. J. DYER.

The subject of clarification in the raw sugar factory, appears to occupy a leading place in the head lines of discussions at the annual meetings of Sugar Technologists, in Hawaii and more recently in the Philippines.[1]

These discussions have originated mainly from complaints from refiners on the "filtrability" of these sugars in comparison with importations from other parts of the world. Now, as a matter of fact this difficulty of filtration did not exist in the earlier days of the Hawaiian industry, say prior to 1895, but in the opinion of many has been brought about by the process of continuous clarification now universal in Hawaii and in the recently constructed Centrals of the Philippines.

Hawaii has practically always exported a centrifugal sugar. The earlier method of clarification was the intermittent process of liming, heating, settling and decanting, or drawing off the individual tanks. This process was handled by Chinese, who were specially adept at this work both from experience and temperament, and the sugar produced was a superior product, about 70 to 75 per cent. of the output being of 98 to 99° polarization. At that time the Pacific Coast market preferred a light brown from the refineries, in preference to the "crushed white" product, so that as a matter of fact the Hawaiian raw sugar as shipped could have gone into direct consumption.

As the industry developed and the mills were enlarged, a process of continuous clarification was much discussed. Such a system was installed at the Spreckelsville Mill in 1880, but was not generally acceptable to the industry at that time. Later about 1895 the Deming System of continuous heating and settling was received favourably; and, while the "high temperature" and "continuous settling" phases of the Deming process were found mythical, what has survived is the Spreckels or Deming continuous heater with intermittent tanks for precipitation or settling. There have been many modifications of these tanks as well as combinations with sand, bagasse and excelsior filters, etc., but there has been no apparent improvement in the clarified juice over that obtained in the Spreckelsville installation.

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[1] Reports on the Manufacture of Raw Sugar in the *I.S.J.*, 1924, 141, 209, 648.

What is known as the Kopke System of centrifugal settling was tried out some years ago, but was abandoned at that time. The equipment was installed in a new factory, and consisted of seven centrifugals with 40 in. diam. containers. These received the limed and heated juice through a surge tank direct from the heater. When the container was filled to capacity with solids, which required about an hour's time, the machine was stopped and the contents were discharged, and another cycle commenced. This system dispensed with settling tanks and filter-presses. From a perusal of the discussions above mentioned, this process is being revived to handle the mud from the Petree and Dorr process in preference to passing the mud through the mills.

From a perusal of literature on the manufacture of raw sugar under date of 1885, in referring to the intermittent process of clarifying, the following appears:—

> "The tempering and heating of the juice is very important in order to obtain a "transparent and wine tint appearance; ebullition must be carefully avoided as it "would break up the floating scum and diffuse it through the mass of the liquor, "producing a hazy effect."

Now with the continuous process as at present practised, the operation seems quite to the contrary, the juice being pumped through "high velocity" heaters where it is presumably brought to the proper temperature, and the coagulent in consequence is thoroughly churned into the liquor so that the expected precipitation in the settling tanks fails of its purpose, and as a result various contrivances for screening the juice are improvised with the idea of eliminating the suspended solids and otherwise clearing up the "hazy effect," etc.

From the writer's observation covering a number of years in the construction of equipment for the production of raw sugar for the refinery, there has been no clarifying system contrived that was more practical or efficient than the intermittent process; and, while the continuous method is desirable for economic reasons, it has failed to reach the standard of the older process.

But the Kopke type of apparatus promised to reach this mark, and in addition dispense with the filter station. It may of necessity now receive the encouragement and thought that the process would seem to merit and thus provide the desired improvement in the clarifying operation.

(*B*) By E. W. KOPKE.[1]

Those concerned in raw sugar manufacturing methods will be interested to know that such progress has been made in the perfection of large capacity centrifugal clarifiers as to render these machines available for raw sugar production, either in connexion with the clarification of juice, the treatment of the mud or settlings, or for the purpose of clarifying syrups or molasses.

The machine, while extremely simple in design and in principles of operation, is the result of some fourteen years of experiments, tests and improvements. During this period, more than thirty-two different principles and arrangements for influencing the introduction of the liquor into the bowl and the liquor already accelerated and under treatment in the bowl were tried, before an acceptable construction was found. Twenty-eight arrangements for influencing the flow of the liquor in the bowl were tested on a commercial scale and some eighteen principles were experimented with in connexion with the discharge of the liquor from the bowl. Problems which appeared trivial and capable of ready solution were frequently only surmounted after a prolonged series of modifications and costly experiments.

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[1] Abridged from *Sugar News*, 1925, 61, No. 21, 73-74.

Centrifugal clarification is of great practical interest because of the unquestionable inadequacy of present sedimentation practices in juice clarification, and the generally recognized advantage to be gained through the removal of insoluble matter which is invariably present in considerable quantities in the concentrated liquors, such as syrup and first molasses. The latter class of impurities are very viscous and in a fine state of suspension, so that their removal cannot be accomplished by filtration or settling with a reasonable degree of speed or economy. With the removal of these insoluble impurities from the syrup and especially from the first molasses, the subsequent low grade boilings are greatly improved, crystallization progresses more rapidly, and drying of the final massecuites is naturally more rapid and free. This final result cannot be realized, however, unless the temperatures involved are properly controlled.

Failure to appreciate or recognize the effect of temperature in the crystallizing characteristics of concentrated sugar solutions has been responsible for unsatisfactory results in several cases where centrifugal clarification has been attempted.

Probably the best evidence of reduced viscosity in low grade massecuites lies in the fact that in one Hawaiian factory where centrifugal clarification of the first molasses was practised for a number of years, the average Brix of the final molasses, as discharged from the centrifugals, was 97·2 for the year. The average purity of the crusher juice in this case was less than 83·0 and only 3·0 sq. ft. of centrifugal area was available per ton of cane per hour for handling all of the low grade massecuites. The average gravity purity of the final molasses was 35·2, with a very much higher ash content than prevails in the Philippines. These results would have been entirely beyond reach without centrifugal clarification of the molasses prior to the final boiling.

In the case of juice clarification by centrifuging, the benefits are more obvious or conspicuous, and may be briefly enumerated as follows :—

(1) Brief period required for handling the juice, since 15–20 mins. after the mill stops, all the juice has been delivered to the evaporators and all the mud is out of the house. (2) A saving of heat which in most factories will amount to several hundred horse-power, since the juice is clarified rapidly and without appreciable exposure to heat radiation. (3) Entire elimination of filter-presses and re-settling tanks. (4) Reduction of 60 to 80 per cent. in labour costs. (5) Small floor area required. For a factory of fifteen hundred tons cane per day capacity, a space of approximately 12 ft. × 70 ft. will suffice for the treatment of the juice and mud.

Installations of these centrifugal clarifiers are now operating on electric drive, water and belt drive, and are exceedingly smooth running, free from vibration and are discharged in a few seconds by means of a specially designed steel plough. As an example of the ease and speed with which they may be stopped, the mud completely discharged, and the clutch again engaged with the regular full flow of juice turned on for another cycle, we find in looking over a long series of trials and tests that one operator stopped, discharged and started, as above indicated, four 24 in. × 40 in. Kopke separators in succession, dumping 1150 lbs. of mud in 3 mins. and 4 secs. The average time for stopping, cleaning and starting again a single machine holding over 400 lbs. of mud was slightly over 2 mins.

Colloids in Cane and Beet Sugar Manufacture.[1]

By H. S. PAINE, M. S. BADOLLET, and J. C. KEANE,
Carbohydrate Laboratory, Bureau of Chemistry, Washington, D. C

(*Continued from page 152.*)

COMPOSITION OF COLLOIDS.

Table III gives data[1] on the composition of total colloid separated from various beet sugar factory liquors by dialysis in an investigation prior to use of ultra-filtration. Furfural-producing substances were calculated as "araban"; determination of galactan was made by the mucic acid method, which yields only approximate values.

Table III.

ARABAN AND GALACTAN CONTENTS OF TOTAL COLLOIDS FROM BEET PRODUCTS.

	Araban, Per cent		Galactan, Per cent.
Evaporator thick-juice	19·6	....	2·0
Evaporator thick-juice	19·9	....	2·5
Blow-up thick-juice	22·7	....	1·1
Cold saccharate juice*	64·0	....	2·3
Cold saccharate juice	32 4	....	0·6
Cold saccharate juice	15·0	....	Lost
Cold saccharate juice	12·9	....	1·6
Cold saccharate juice	14·8	....	1·0
Cold saccharate juice	23·0	....	1·6
Hot saccharate juice*	10·1	....	Lost

Examination of *Table III* shows that a considerable proportion of the total colloid, and probably a higher production of the reversible fraction, consists of furfural-producing material. The amount of galactan present is, at most, exceedingly small and its presence may even be regarded as doubtful.

Table IV represents data[2] pertaining to the composition of total colloids separated by dialysis from two samples of Steffen beet molasses.

Table IV.

COMPOSITION OF COLLOIDS SEPARATED FROM STEFFEN BEET MOLASSES

	Sample 1, Per cent.		Sample 2, Per cent.
Ash in sample	—	....	10·3
CaO in ash of sample	—	....	0.3
Colloid in sample (per cent. on sucrose)	1·6	....	2·4
Ash in colloid	4·2	....	5·6
CaO in colloid ash	25·1	....	33·2
Colloidal Ca compounds (per cent. on total CaO)	—	....	69·8
Araban (per cent. on colloid)	32·8	....	21·8
Nitrogen (per cent. in colloid)	—	....	2·8
Nitrogen (per cent in sample)..	—	....	1·3
Colloidal nitrogen compounds (per cent. on total nitrogen)	—	....	2 5

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[1] Paper (here slightly abridged) presented before the Division of Sugar Chemistry, American Chemical Society, at the 68th Meeting of the American Chemical Society, September 8th to 13th, 1924. (Already briefly abstracted *I S.J.*, 1924, 598.)

* Saccharate prepared by the Steffen molasses desugarization process.

[2] These data were obtained by V. BIRCKNER, of this laboratory, to whom acknowledgment is made.

Data in *Table IV* regarding distribution of calcium compounds in beet molasses show that the largest proportion is in colloidal form.[1] This conclusion, however, is subject to the reservation that molecularly dispersed calcium compounds may have been retained in the colloid mass by adsorption.

In *Table V* are shown data regarding per cent. furfural-yielding substances (calculated as araban) in various beet sugar factory products.

Table V.

ARABAN CONTENT OF TOTAL COLLOIDS FROM BEET PRODUCTS

Sample	Araban, Per cent
Diffusion juice—	
1	6·5
2	1·6
3	5·2
Evaporator thick-juice	23·7
Cold saccharate—	
1*	28·8
2	24·9
3	23·7
Hot saccharate—	
1*	26·9
2	18·7
3	8·8
Saccharate milk—	
1*	28·3
2	30·6
3	24·3

In another series of experiments the per cent. of araban in total colloids varied from 20·7 to 36·3 (7 samples) in saccharate milk and from 12·6 to 27·0 (9 samples) in thick-juice. The foregoing data show that the proportion of total colloids represented by araban is of the same approximate order of magnitude (usually 15 to 35 per cent.) in evaporator thick-juice, cold and hot saccharate, and saccharate milk, and is considerably larger than in the case of diffusion juice. Considering that furfural-yielding material is in general of typical emulsoid character, this indicates that double carbonation removes a considerably greater proportion of "suspensoids" than of emulsoids. By "suspensoids" is meant, strictly speaking, colloids of less highly solvated character than typical emulsoids, but not of purely suspensoid type. Generally speaking, typical emulsoids tend to remain largely uneliminated in cane and beet sugar manufacturing process. In *Table I* it is seen that the reversible fraction in beet molasses amounts to as much as half of the total colloids. The various samples compared were not all obtained during the same period or from the same factory; hence, rigorous comparison cannot be made in the respect mentioned above.

In a previous unpublished investigation[2] a typical emulsoid of gum-like character was isolated from beet molasses after rigorous dialysis. This material, after purifying treatment, still contained 1·4 per cent, ash; it was optically-active and the apparent $[\alpha]^{20}_{D}$ was — 28·7°. After being hydrolysed by acid the apparent

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[1] *Cf.* in this connexion, e g., Luk-Janov, *Deut Zuckerind.*, 1914, 39, 610, in the literature relative to influence of calcium compounds on the viscosity of beet sugar liquors.

* Steffen molasses desugarization process

[2] PAINE and WALTON, "A Study of Beet Gum: Separation from Cane Molasses" presented before the Section of Sugar Chemistry and Technology at the 61st Meeting of the American Chemical Society, Rochester, N.Y., April 25th to 29th, 1921 *I.S.J.*, 1921, 626.

[α]$^{20}_{D}$ was + 57·5°. This material possibly represents a stage in the degradation[1] (under influence of alkaline conditions of the factory process) of gum originally derived from beets.

CATAPHORESIS.

Table IV gives the results of ultramicroscopic cataphoresis measurements.

The colloidal particles had a negative charge (agreeing with many water dispersions). The raw cane sugar samples were examined in a 26 grms. per 100 c.c. solution; while the beet molasses samples were diluted for examination to a solution containing 0·5 per cent. solids. Measurements in the case of molasses were rendered difficult at even moderate concentrations owing to the relatively high concentration of electrolytes. The most suitable conditions for cataphoresis measurements in the case of cane and beet products are being further investigated and the data in *Table VI* are presented merely by way of preliminary interest.

Table VI.

ULTRAMICROSCOPIC CATAPHORESIS MEASUREMENTS.

Material. Raw Cane Sugar	Velocity of Particles (μ per sec per volt-cm).	Material Beet Molasses.	Velocity of Particles (μ per sec per volt-cm)
1	0·32	1	3·09
2	0·44	2	2·91
3	0·49	3	2·53
4	0·64	5	2 88

SURFACE TENSION AND FOAMING.

Table VII shows the depressing effect on σ of a pure sucrose solution of various proportions of reversible colloid from beet molasses.

Table VII.

RELATION BETWEEN COLLOID CONCENTRATION AND SURFACE TENSION.
(Temperature, 20° C.)

Sucrose Concentration, Per cent. Solids by Weight.	Colloid Concentration, Grms. per 75 c.c.	σ Dynes per cm.
21·1	0·000	75·0
21·1	0·045	73·8
21·1	0 090	60·6
21·1	0·135	59·9
21·1	0·180	58·8
21·1	0·225	56·4

If the data of *Table VII* are displayed graphically, the pronounced effect of initial small additions of emulsoid is distinctly apparent. The variation in form of the σ-concentration curve for emulsoids from various sugar factory products and the influence on σ of organic and inorganic salts present therein must be determined before any conclusion can be reached regarding the value of surface tension measurements as a practical factory operating criterion. The form of the σ-concentration curve for the water-reversible fraction may vary with the qualitative character of the latter; and, if such should prove to be the case, this would constitute a most sensitive criterion for changes in composition of this important fraction. The existence of minima in the curve may be of considerable significance.[2]

In connexion with further investigation of surface tension phenomena the foaming of syrups prepared from various samples of granulated sugar was studied. The following simple test was formulated: To 50 grms. of sugar in a 200-c.c. beaker, tall type, 25 c.c. of water were added and the solution heated gradually at a uniform rate to 117·8°C. (244° F.). The time periods required to reach the first boiling point, and 117·8° C. were 3·5 to 4 mins. and 8 to 9 mins., respectively. After solution of the sugar the beaker was marked at the liquid level, and upon reaching the boiling point when foaming commenced a mark was made on the beaker at the level of maximum foaming. The data obtained are expressed in *Table VIII* in terms of volume.

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[1] O'SULLIVAN, *Proc. Chem. Soc.*, 1889, 5, 166, 1891, 7, 131; 1899, 15, 156.

[2] DU NOÜY, *Science*, 1924, 59, 580.

Corresponding measurements of σ showed that the values of σ were in inverse order to the volumes at the two boiling points shown in *Table VIII*. Foaming is due to emulsoid depression of the surface tension, and resulting formation of a gas-(air)-in-liquid dispersion. The colloid exerts a stabilizing influence on this air-in-liquid emulsion. (See in this connexion the well-known stabilizing influence of emulsoids on liquid-in-liquid emulsions.) The behaviour of the colloid in the sugar is quite similar to the familiar action of saponins.

Table VIII.

FOAMING EXPERIMENTS.

Sugars.	Volume before Boiling. c c	Volume at first Boiling Point. c c.	Volume at Boiling Point 117 8° C. (244° F) c c.
11	60	160	98
12	60	172	104
13	60	193	115
14	60	70	85
15	60	70	75
16	60	85	90

Probably the amount of air retained in the interstices between crystals is greater in a mass of small sucrose crystals than in an equal mass of larger sucrose crystals, thereby making the volume of air immediately available for dispersion greater in the former case than in the latter. The value of σ, as influenced by the colloid present and not the size of sucrose crystal, is the determining factor, however. This is shown by the fact that the relation in foaming volumes of Sugars 13 and 14 remained unchanged when only the portion of the former larger than 30 standard mesh and the portion of the latter smaller than 50 standard mesh were used.

Foaming, involving the depressing influence of emulsoids on σ, is characteristic of various stages of cane and beet sugar factory procedure. In the operation of producing cane syrup by open-pan boiling and skimming of cane juice (also in the use of brush pans as practised in Louisiana), unconscious advantage is taken of the principle that as a result of surface adsorption colloids which depress surface tension are present in greater concentration in the surface layer of a liquid than in the remaining portion. By frequently skimming off the surface layer and foam, a considerable proportion of the emulsoids present may be removed as a result of progressive displacement of the adsorption equilibrium. In a test in which a solution of Sugar 11 (*Table VIII*) was boiled, the values of σ (at 26 per cent. constant sucrose concentration) before and after skimming were 66·2 and 73 5 dynes per centimetre, respectively. When a solution of Sugar 14 (*Table VIII*), which exhibited practically no foaming, was boiled the values of σ before and after skimming were 74·0 and 74·1—i. e., constant values characteristic of pure sucrose solutions.

CONCLUSIONS.

As an important deduction from all the foregoing, it is concluded that the mooted question of influence of cane and beet pigments upon the production of off-colour granulated sugar resulting from various factory processes may be accurately investigated by separating the pigments and other colloids from typical samples of the sugar produced, and then reasoning *a posteriori* to the initial stages of the factory procedure, instead of depending solely upon *a priori* reasoning based upon the pigments present in cane and beet juices. Since, so far as the sugar itself is concerned, one is not interested in pigments which are either previously eliminated or do not contaminate the sugar crystals, some useless labour may thus be avoided and practical results arrived at more quickly. A research of this character is now in progress and the results will be reported in the near future.

It is helpful, in considering the effect of colloids on sugar manufacture, to keep in mind that this consists essentially in (*1*) influence on viscosity and surface tension of factory liquors, and (*2*) influence on quality of sugar, although the direct manifestations may be many and varied, e.g., slow boiling, delayed crystallization, foaming, poor filtration, reduced sugar yield, off-colour sugar, etc.

The results reported in the present paper are to be regarded as a preliminary testing of the tools of colloid research as applied to sugar manufacture. The writers plan to also test other criteria, as well as to extend the studies already indicated, and have confidence that the present status of colloid chemistry makes it possible to secure constructive data of practical importance to the sugar industry. In addition to those already mentioned, the following studies are involved: determination of isoelectric point; influence of various cane and beet colloids on viscosity of sucrose solutions within certain limits of (*a*) sucrose concentration, (*b*) temperature, and (*c*) ratio of colloid to sucrose; effects produced by varying degree of solvation of emulsoids.

Patterson's "German-English Dictionary for Chemists" although still in its first edition has reached its fifth printing (with addenda). This dictionary is an almost indispensable aid to the English-reading chemist who peruses German literature. It has been compiled with remarkable care and thoroughness, and differs from a number of similar works in the first place by being reliable, comprehensive and up-to-date, and in the second by including a useful general vocabulary.

According to a Department of Overseas Trade report from Chile, the Compania Industrial y Azucarera de Tacna, formed some years ago with the object of developing the cane sugar industry and making Chile independent of Peru, from whom she imports annually some 90,000 tons of sugar, has made little progress, and up to the present time produces barely sufficient sugar to supply the needs of the town of Tacna. Irrigation works are being gradually carried out, opening up large areas to cultivation, but development remains almost stationary. Various commissions have studied the establishment of the beet sugar industry, and have come to the conclusion that a subsidy will be necessary during the first 15 years, representing a tax of 30 centavos per annum per head of population. There seems little likelihood of the Government finding this money for some years to come.

Since the Honolulu Iron Works Company (for five decades a Hawaiian corporation doing business in the Hawaiian Islands) decided in 1905 to open a purchasing and engineering office in New York, the business has developed with big strides Orders for much reconstruction work and for the erection and equipment of new sugar factories soon flowed in from Porto Rico, Cuba, Mexico and other countries, and now at times the New York office staff (designing, purchasing and accounting) reaches as high as 100 persons. The year 1924 was a particularly busy one for this Eastern Division, as the New York branch is termed. One notable achievement was the obtaining of a contract to build a large sugar refinery in Tokio, and another to move a big beet sugar factory from California to Montana for the Holly Sugar Company. In this last case all the factory buildings will be new and will be built to the drawings and specifications of the Honolulu Iron Works Company, who are also acting in an advisory capacity to solve the engineering problems in connexion with this factory.

Correspondence.

CANE DISEASE CONTROL.

To the Editor, "The International Sugar Journal."

Sir,—The letter by Dr. W. E. **Cross** on page 27 of *The International Sugar Journal* for January, 1925, has just been brought to my attention.

The paper by myself, which he criticizes, was presented at a meeting of the Pan Pacific Union in Honolulu, the main thesis of which was that the promiscuous importation of seed cuttings of sugar cane, especially from Oriental cane countries, was a menace to the sugar industry of countries of the Western Hemisphere because of the possibilities of introducing new cane diseases and injurious insects. If Dr. Cross does not agree with this thesis he is twenty years behind the times.

In the course of our development of this thesis mosaic disease was cited as an example of injury resulting from the spread of a new disease. No statement was made nor inferred concerning Dr. Cross, or any other individual, as introducing mosaic disease into the Argentine or any other cane country. Apparently, however, Dr. Cross is suspiciously sensitive on the point of who introduced mosaic disease into the Argentine and West Indian countries. Since Dr. Cross has brought himself into prominence in this connexion, the following statements may be of interest from page 4 of U.S. Department of Agriculture, Bulletin 829, by E. W. Brandes :

> "At Santiago de las Vegas it (mosaic disease) was found on plants recently imported from Louisiana and Tucuman, Argentina. The latter plants had come originally from Java."
>
> Also :
>
> "Infected cuttings have been received in both Porto Rico and Cuba from Tucuman, Argentina. . . . ."

To those who may not know Dr. Cross, he has something to do with an Experiment Station at Tucuman and in view of the heat shown by Dr. Cross on this question we infer that perhaps he was the guilty party in distributing these diseased plants in the West Indies. Since Dr. Cross feels so heated about the question we are quite ready to agree that it is possible that mosaic disease in the Western Hemisphere did not entirely emanate from Tucuman, but there is considerable definite evidence that diseased cuttings were promiscuously shipped from Tucuman.

I also read with amusement about my facile pen which filled two pages of *The International Sugar Journal*, while Dr. Cross, with even greater facility, covers six pages of the same journal, with what seems to us to be an argument without definite aim or objective except to clear himself of a charge which was not brought against him.

Finally, as a matter of common interest to the sugar industries of countries of the Western Hemisphere, forgetting for the time these differences between individuals, the selection, inspection and quarantine of cane cuttings for importations from one country to another is very important to prevent the introducing of new cane diseases and injurious insects. Dr. Cross, as he states, possibly cannot be expected to be familiar with all the cane diseases of Oriental countries, but it would be expected that he would be acquainted with the need for selection of disease-free cuttings in the country of origin, and inspection and quarantine of new cane plants in the country into which they are to be introduced ; such procedures have been well established by progressive experiment stations for at least fifteen years or more. It is much easier and cheaper to prevent the introduction of these things than to combat them once they have obtained a foothold ; in other words, such semi-informed individuals as Dr. CROSS can do a great deal of harm and cause serious financial losses to innocent cane planters by lack of knowledge of the essential measures to prevent the introduction of new cane diseases and insects.

May I ask that this letter be given space equally as prominent as that given to the diatribe by Dr. CROSS ?

Sincerely yours,

H. ATHERTON LEE,
Pathologist, Experiment Station,
Hawaiian Sugar Planters' Association.

Publications Received.

Fuel for Motor Transport : Third Memorandum : Power Alcohol from Tuber and Root Crops in Great Britain. Department of Scientific and Industrial Research ; Fuel Research Board. (H. M. Stationery Office, Adastral House, Kingsway, London, W.C. 2.) 1925. Price : 9d. net.

This Memorandum, prepared by Sir FREDERICK L. NATHAN, deals in detail with the possibilities of using potatoes, and mangolds and Jerusalem artichokes as raw material for the production of power alcohol in this country, a considerable amount of experimental and statistical data being presented. It appears to be very unlikely that potatoes could be grown at a price making it possible to obtain alcohol from them for use as an alternative fuel to petrol at anything approaching its present price. Stated briefly, 1 ton of potatoes produces 20 galls. of 95 per cent. alcohol, so that every £1 it costs to grow a ton of potatoes is equivalent to 1s. on a gallon of alcohol for raw material. Mangolds are easier to grow, and their carbohydrates are in the form of sugar, but this plant is very susceptible to frost, so that it cannot be grown in the North of England or in Scotland. One ton of this crop makes about 8 galls. of 95 per cent. alcohol so that every £1 it costs to grow a ton is equivalent to about 2s. 8d. on a gallon of alcohol for raw material. But, whereas in Great Britain the yield per acre in the case of potatoes is only 5·7 tons, in that of mangolds it is 19 tons ; and if potatoes are used the cost per gallon for raw material would be 7s., and if mangolds about 3s. 9d. Jerusalem artichokes will grow in almost any soil, so long as it is well drained and yields 10–12 tons per acre, giving 15–25 gallons of 95 per cent. alcohol per ton of lakers. Cost figures are not given for the production of alcohol from this crop. A pure resistant cellulose to the amount of about ¼ ton per acre, could be made from artichoke stalks, which material would be very suitable for certain purposes. This work is being continued.

Final Report on the Departmental Committee on the Use of Preservatives and Colouring Matters in Food. Ministry of Health. (H. M. Stationery Office, Adastral House, Kingsway, W.C. 2.) 1924. Price : 1s. 6d.

This is the full report on the use of preservatives and colouring matters in food, a summary of which has been given in a paper noticed last month.[1] It deals with questions as : the effect of various preservatives on the consumer ; how far they can be dispensed with ; colouring matters ; and summary of conclusions and recommendations; whilst in the appendices *inter alia* are found information on the laws and regulations in different countries with references to the use of preservatives and colouring matters in foods.

Oil Testers. (Sir W. H Bailey & Co., Ltd., Albion Works, Salford, Manchester.) 1925. Price: 1s., post free.

All large users of machinery should be in possession of apparatus by which the value of the lubrication oil they use may be estimated seeing that the purchase of inferior oil means loss of money Oil Testing Machines are described and illustrated in the pages of the booklet, these enabling the nature and quality of oils to be appraised for any particular purpose in view. Several of them are of the well-known Thurston type, which determines the co-efficient of friction, and also gives indications regarding the lubricating quality, the liability of the oil to gum, its durability, and like values. Other apparatus shown here are Redwood's Viscometer, Abel's flash point tester, and Sir W. H. Bailey's pendulum test Bailey's Oil Testers are used by the British Admiralty, the Crown Agents for the Colonies, by railways and public corporations, as well as by a great number of well-known firms

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The Chemical Engineering and Chemical Catalogue. (Leonard Hill, 173, Fleet Street, London, E.C. 4.) Edited by D. M. Newitt, Ph.D., B.Sc., A.R.C.S. 1925. Price: £1 1s. 0d.

This is a catalogue of heavy and fine chemical raw materials machinery, plant and equipment (compiled somewhat on the lines of the American publication The Chemical Engineering Catalog), described as being "standardized," condensed and cross-indexed. It gives by no means a general list of firms catering for the chemical industry, and under the heading of sugar making and refining machinery it is noticeable that several of the leading firms are conspicuous by their absence. The work is well arranged and carefully indexed, and it is hoped that future editions may include a more representative number of firms.

A New Principle in Filtration. (The Stream-Line Filter Co., Ltd., 64, Victoria Street, Westminster, S.W. 1.) 1925.

This pamphlet explains the principle of the Hele-Shaw apparatus, and describes a laboratory filter, which is claimed to be a "quantitative instrument for analytical research of industrial materials," the pressure on the pack being adjustable to a fine degree. In this instrument it is notable that, contrary to the original type, the outer surface of the pack is exposed to view, so that the liquid leaving after filtration is exposed, and the flow can be watched. After filtration, the solids collected can be removed without disturbing the pack.

A Guide to the User of Tax-free Alcohol. (David Berg Industrial Alcohol Company, Philadelphia, Pa., U.S.A.) 1925.

This booklet collects the formulæ authorized by the Bureau of Internal Revenue, U.S.A., to date, of denatured alcohol, suitable for different industrial purposes.

Prospectus and Syllabus of Instruction of the College of Agriculture, Mauritius. 1924-25. (College of Agriculture, Mauritius) 1925.

Particulars regarding the Staff (including Dr. TEMPANY as Principal, and Mr. L. BAISSAC as Sugar Technologist), fees, regulations, and details of the courses are given here. The syllabus headed "Sugar Technology" relating to manufacture, and chemical control, is a comprehensive one. Those relating to agronomy, pure and agricultural chemistry, physics, botany and mycology, zoology and entomology, etc., are likewise very complete, and it is evident that the student who will have qualified as a sugar technologist after having followed the lectures and practical work specified, and will have passed the examinations, will be a very thoroughly trained man.

Brevities.

The American Hoist and Derrick Company, of St. Paul, U.S.A., have a new General Catalogue and a new Locomotive Crane Catalogue ready for distribution to all those interested.

Messrs. Watson, Laidlaw & Co., Ltd , of Glasgow, have secured the order to supply the new Ipswich beet sugar factory with a battery of electrically-driven centrifugals, as well as an installation of water-driven centrifugal machines and pumps.

Arthur D. Little, Inc., have developed a new vapour phase petroleum "cracking" process, which yields a motor spirit possessing remarkable properties as an anti-knock motor fuel.[1] A large volume of gas, from which various alcohols (isopropyl, butyl, amyl, hexyl, etc.) can be obtained, is also produced.

Two recent patents deal with "edge filters," that is, filters on the principle of the Hele-Shaw stream-line apparatus recently described.[2] One of these, taken out in the name of E. A Forsberg,[3] introduced improvements for facilitating the removal of solid matter from the cores of such filters, such devices claiming to obviate the tendency to destroy the edges of the thin sheets of filtering material.

In the course of their recent paper on colloids[4] H. S Paine, M. S Badollet, and J. C. Keane, stated ultra-filtration to be an excellent procedure in connexion with the preparation of purified sucrose for laboratory investigation. Removal of colloid contamination is thus readily effected, and solutions of high density which are brilliantly clear are thus obtained.

During 1924 about 200 acres in Scotland[5] were put under cultivation for sugar beets, but these trials were not as favourable as was expected, the conclusion drawn being that more knowledge and more experience in methods of cultivation were necessary before the enterprise can be considered ready to be handled commercially. Haddington, Fife, Forfar, and Moray gave the most encouraging yields, averaging over 7 tons of roots per acre with a sucrose content of 15·5 per cent.

A long-felt want amongst chemists is an accurate and speedy method of determining sodium (other than as a soluble salt, e.g., the sulphate). A. Kling and A. Lassieur[6] now report very favourably on the Blanchetière process,[7] which consists in precipitating the triple acetate of sodium, magnesium and uranium, a compound forming in beautiful crystals, only slightly soluble in excess of the precipitating reagent. Quite convincing results demonstrating the reliability of the method under ordinary conditions are published by the two authors named (who are on the staff of the Paris Municipal Laboratory).

In the course of a paper on the Benson Boiler read before the Institution of Chemical Engineers,[8] Mr. David Brownlie, M.I.Mech E., said that undoubtedly the most remarkable of all these new developments is the conversion of water on a practical scale into steam under the actual critical conditions of 3200 lb. per sq. in. pressure and approximately 706° F. (375° C) dry saturated steam, as represented by the work of Mark Benson. If this method is proved to be a commercial proposition, then it signifies a revolution in the whole science of steam power generation, enabling something like 30-35 per cent. thermal efficiency to be obtained from the raw coal to the switch-board instead of, as at present, about 20 per cent. for a few of the latest super-power stations, 14-17 per cent. for ordinary high-class stations, 10-20 per cent. for the best type of large reciprocating steam engine, 7-8 per cent. for the ordinary industrial condensing steam engine, and 4-5 per cent. for the steam locomotive. What has prevented the extended use of very high pressure has been constructional troubles, chiefly because of ebullition caused by latent heat absorption, the main difficulty being that of building a boiler, but also, to a lesser extent, steam pipes, and an engine or turbine that will stand the pressure. But Benson has now solved the problem by the simple and ingenious method of going right up to the critical conditions of pressure and temperature, and converting water into steam at the same volume, and therefore without the absorption of any latent heat, with no ebullition or "boiling" so that the coil generator is not a "boiler" at all.

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[1] *Industrial and Engineering Chemistry* (*News Edition*), 1925, 3, No. 4, 7.
[2] *I.S.J.*, 1923, 628. [3] United Kingdom Patents, 226, 274; 226, 275; 226, 277; 226, 278; and 226, 470.
[4] *I.S.J.*, 1925, 147. [5] *The Glasgow Herald*, March 9th, 1925.
[6] *Bull. Soc. Chim.*, 1923, 807. [7] *Chimie et Industrie*, Dec, 1924. [8] See also *I S.J.*, 1924, 442.

Review of Current Technical Literature.[1]

DISTRIBUTION OF SUGAR TO THE PLANTER IN THE P I. IN EXCHANGE FOR CANE [2] *Herbert Walker* *Sugar News, 1924, 5, No 11, 627-630*

Practically all schemes for estimating the weight of sugar to be allotted to each farmer in exchange for the quantity and quality of his cane delivered are based on weight of cane and polarization and purity of crusher juice, using a more or less complicated factor or series of factors to arrive at an assumed weight of sucrose and gravity purity for the syrup, the percentage of raw sugar obtainable being then calculated by the *s j m* formula, using for *s* and *m* either the weekly or periodical averages But the total calculated sugar never checks absolutely with that actually obtained, as the result of unknown losses, analytical errors, and variable factory efficiency , so that the calculated and obtained values must be corrected for by the use of a factor correlating them It is pointed out here that for estimating the boiling house recovery for calculating this distribution, the *s j m* formula without some modification is not a fair basis Assume a factory grinding up to full capacity with syrup of 88° gravity purity producing a final molasses of 38° gravity purity, the calculated *s j m* boiling house recovery being 93 11 per cent Let the average syrup purity drop to 80°, when the calculated recovery, still based on 38° purity molasses, would be 86 03 But this could not be obtained in practice since the additional non-sucrose introduced with the 80° purity syrup would more than double the amount of molasses produced Figures derived from actual experience indicate that a drop in syrup purity from 88 to 80° would increase the final molasses purity from 38 to about 42° The boiling house recovery would then be 83 45 instead of 86 03 per cent , from which it is evident that for distribution of sugars the *s j m* formula holds good only at an infinitely large boiling house capacity Fortunately sudden drops of average purities as great as the above seldom occur, but the influence of any individual lot of cane of low purity makes itself felt in overtaxing the boiling-house and lowering the general recovery It is therefore unfair to planters sending in high purity cane to distribute the full *s j m* recovery to those delivering low purity cane An equitable means of penalizing low purities would be to base the assumed purity of final molasses resulting from each lot of cane on a sliding scale depending on the purity of the crusher juice, the following empirical relationship based on average conditions being suggested —Assume that an 88° purity juice will yield 38° purity molasses and each increase or decrease of two points in juice purity will lower or raise the waste molasses purity by one point

Purity Crusher Juice .	92	90	88	86	84	82	80	78 etc
Assumed Purity Molasses	36	37	38	39	40	41	42	43 etc

With sugar purities of 97 5°, the calculated boiling house recoveries at different juice purities would, at average purities, differ only slightly from present calculations, but would fall off rapidly with decreasing juice purities, reaching 0 at 54° juice purity, the following comparison showing the extent of variation

Purity Juice .	92	88	84	80	70	60	54
S J M Recovery, 38° Molasses	96 18	93 11	89 74	86 03	74 91	60 08	48 55
S J M Recovery, Variable Molasses	—96 50	93 11	88 82	83 45	63 44	28 57	0
Difference . . .	+ 0 32	0	—0 92	—2 58	—11 47	—31 51	—48 55

A table based on the above is simple to prepare and gives a smooth curve of premiums and penalties without any abrupt changes. Therefore the following is a fair and easily derived method of distributing sugar From *s j m* yields, taking 97 5 *s* and a variable *m*, prepare a table of boiling house recoveries at varying purities of *j* The factor for converting from polarization of crusher juice to sucrose extracted per cent cane is immaterial, since it has to be corrected for anyway To obtain the weight of sugar due to each planter, multiply the polarization of crusher juice by the yield corresponding to its purity, then by the weight of cane Correct as usual each week by multiplying individual distribution by the factor correlating the total sugar produced and the total sugar calculated

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[1] This Review is copyright, and no part of it may be reproduced without permission — Editor, *I S J*

[2] See also *I S J*, 1921, 623 , 1922, 46, 47, 77, 438 , 1923, 213 , 1924, 613

COMPARATIVE COSTS OF CANE SUGAR PRODUCTION. *Carlos L. Locsin. Sugar News, 1925, 6, No. 2, 105.*

Data compiled from statements issued by the U. S Tariff Commission have been arranged by Mr. LOCSIN in the following way, and give fuller details than have previously been reported in these columns.[1]

	CUBA 1922.		HAWAII 1922.		PORTO RICO 1922.		LOUISIANA 1922-23.	
	Cents Gold per lb.	Pesos per Picul.	Cents Gold per lb	Pesos per Picul.	Cents Gold per lb.	Pesos per Picul	Cents Gold per lb.	Pesos per Picul.
Cost of cane ..	1.1583	3.23	2.6362	7.35	2.9335	8.18	3.5314	9.85
Manufacturing expenses ..	0.2758	0.77	0.3533	0.99	0.3575	1.00	0.7655	2.13
Repairs and maintenance	0.1386	0.39	0.0972	0·27	0.1860	0.52	0.3418	0.95
Administration and general..	0.1696	0.47	0.3112	0.87	0.2255	0.63	0.1764	0.49
Fixed charges (*a*) ..	0.2736	0.76	0.5857	1.63	0.3045	0 85	0.3166	0.88
Interest paid (*b*)	0.1496	0.42	0.0409	0.14	0.1047	0.29	0.1731	0.48
Interest at 6 % on investment	0·3440	0.96	0.5060	1.41	0.3233	0.90	0.2199	0.61
TOTAL f.o.b. mill	2.5095	7.00	4 5305	12.66	4.4350	12.37	5.5247	15 39
Less credit (*c*) for receipts ..	0.0191	0.05	0 0110	0 03	0 0623	0.17	0.1731	0.48
NET f.o.b. mill	2.4904	6.95	4 5195	12.63	4 3727	12 20	5 3516	14.91
Marketing costs	0 2265	0.63	0.4734	1.32	0.2621	0 73	0.1204	0.34
TOTAL c.i f. N.Y., or Frisco	2.7169	7.58	4.9929	13.95	4.6348	12.93	5.4720	15.25
Cuban tariff ..	1.7648	4.92						
TOTAL Cuban cost duty paid, N.Y.	4.4817	12.50						

THE BEET SUGAR INDUSTRY IN ENGLAND: ITS HISTORY AND PROBLEMS. *Geoffrey Fairrie. The Chemical Trade Journal, 1925, 76, 101.*

Attempts made to produce beet sugar in this country previous to the initiation of the industry are reviewed shortly; certain agricultural and manufacturing difficulties are mentioned; and carbonatation with sulphitation as a process of making white sugar is denounced as defective. "To-day, the white beet sugar which is imported from the Continent comes from refineries equipped with bone charcoal filtration plants . . . . By the use of animal charcoal, the sugar refiner is able to produce from the raw material, whether it be of beet or cane origin, white refined sugar of 99·99 per cent pure sucrose content . . . . The use of decolorizing carbon of vegetable origin is superior to the sulphur dioxide bleaching process, but inferior to the use of animal charcoal . . . . So far as the writer is aware none of the beet factories constructed or planned in the United Kingdom has a bone charcoal filtration plant . . . ."

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[1] *I.S J.*, 1924, 3.

(*a*) Includes only money actually paid out on loans, bonded indebtedness, and cumulative preferred stock, if any Rent has also been included only where money has been actually paid out.

(*b*) Interest actually paid on borrowed capital.

(*c*) Proceeds from by-products.

Review of Current Technical Literature.

DETERMINATION OF THE DENSITY, HARDNESS, ETC., OF REFINED SUGARS. *T. Bonwetsch.* *Centralblatt fur die Zuckerindustrie, 1925, 33, No 4, 98-99.*

In his book "Der Zucker in Russland und im Auslande" the author describes his "pondoscope," a simply constructed apparatus indicating directly the density of material of sugar with a fair degree of accuracy. He also gives an account of his tests with a miniature hydraulic press for measuring the hardness or resistance to crushing of such material, some of his results being summarized in the following table: –

Origin and Colour of the Sugars	DENSITY With Water at 20 C	DENSITY Per cent Density of Pure Sucrose	Resistance to Crushing in kg	Rapidity of Solution in Water, Min.
Russian lumps (white)	1 255	79·3	66	10½
Dutch ,, ,, ...	1·170	74·0	37	5½
German ,, (yellowish).	1·070	67·6	22	4
Russian cubes (white) ..	1·250	78 9	67	11
German ,, ,, ...	1 170	74·0	45	4½
,, ,, (yellowish) .	1·130	71·4	22	4
Austrian ,, ,,	1 170	74 0	44	5
,, ,, (white)	1·120	70·8	30	4
Spanish ,, ,, ..	1·140	72·1	34	4½
Italian ,, ,, .. .	1 120	70·8	42	4½
French slabs ,, ...	1·090	68 9	51	8

BRUNLER'S INTERNAL COMBUSTION BOILER. *O. Brunler, A. E. Alliott,* and others. *(A) The Chemical Trade Journal, 1925, 76, No 1963, 10-11. (B) Ibid , 1925, 76, No 1970, 232-233.*

(*A*) In the combustion of oils and gases, heat efficiency values have been obtained which are not in accordance with accepted theory on the subject, such values indicating an efficiency over 100 per cent. Several theories have been propounded for the explanation of such anomalous results (such as the conversion of the electric vibrations produced by the flame into useful energy), but none appears to be generally acceptable. Thirty years ago the author's father obtained an efficiency of 200 per cent. from paraffin in an engine working on the same principle as the Diesel, and from these experiments he was led to investigate the possibility of burning a flame in water. It was many years before he actually succeeded in effecting complete combustion ot fuel in contact with water, but later an apparatus was devised in which the flame burns quietly in the water contained in a generator body. Apparatus working on this principle is now in use on the industrial scale in some factories, e.g , for the evaporation of potash solutions, where, using tar oil of 9000 calories per kg., the evaporation was 18-20 kg. of water per kg. of oil, whereas theoretically the figure is 14·6. (*B*) At a joint meeting of the Institution of Chemical Engineers and of the Chemical Engineering Group of the Society of Chemical Industry, held on Feb. 11th Mr. A. E. ALLIOTT (Chairman), said that in comparing the efficiency with that of a multiple effect, it looked as though the plain Brunler burner applied directly to the evaporation of a chemical would be somewhere of the order of the efficiency of an ordinary double effect, or possibly a little better, depending on circumstances. Whether the steam from that evaporation could be actually applied to conducting a further evaporation, so making a double effect job of it, was a matter for experiment. Mr. H. GRIFFITHS, said he did not think the Brunler boiler would compare favourably, for straightforward evaporation, with a multiple effect plant It might be that it had a special value for a solution presenting special difficulties connected with heat transfer, but heat transfer was not everything Professor J. W. HINCHLEY said Brunler's boiler was extremely ingenious, and he had been very much impressed with the claims made for it, but he would be very sceptical indeed, however, with regard to the 120 per cent. thermal efficiency. He had not even mentioned radiation, losses, which were often a considerable part of the losses in an ordinary boiler trial. He doubted Mr. Brunler's single-effect evaporator to be as efficient as a double-effect or triple-effect evaporator. Mr. BRUNLER, replying to the discussion, said the solution would be fed into the generator; the flame burning in the chemical solution evaporated the water of the solution, and the steam which was passing over to the steam reservoir passed to the engine, and drove the engine; or, if the solution were concentrated at low pressure, the steam was used for preheating another solution. Where chemical solutions containing salts had to be crystallized, the burner was surrounded by a water jacket, through which cold water was passed, cooling the burner continuously. There was hardly any difference between the pressure in the steam reservoir and in the steam generator The temperature of the steam was 350° C. Radiation losses had not been considered in arriving at the efficiency of 120 per cent., but if these were taken into account, there would be a thermal efficiency even higher than 120 per cent. Doubt had been expressed by Professor HINCHLEY as to the high efficiency obtained with the boiler in carrying out evaporations. He (Mr. BRUNLER) intended to arrange a demonstration plant in London, and would invite Professor HINCHLEY to carry out his own tests in order to convince himself that efficiencies higher than 100 per cent. were obtained.

OFFICIAL EXAMINATION OF THE "RAPID" BEET JUICE EXTRACTION PROCESS IN THE CALBE (a. d. SAALE) FACTORY, BY THE INSTITUT FÜR ZUCKER-INDUSTRIE. *A. Herzfeld. Vereins-Zeitschrift, 1925, 1-33.*

In an official test carried out by Prof. Dr. HERZFELD at the Calbe factory, the "Rapid" process was well approved, about 12,000 ztr. (about 600 tons) of roots being treated in only one apparatus in 24 hours, while giving a good extraction with a moderate draw-off. No actual sugar losses were observed to occur, since that amount of sugar which had not all passed into the juice (about 0·45 per cent. on the roots) was recovered in the pulp. Extraction proceeded in the several compartments of the apparatus as regularly and evenly as in a diffusion plant, though the time necessary was distinctly less, namely about 30 min., and no stoppages occurred. Scalding by the Bosse process gave juice free from coagulable substances, and did not lead to frothing. All the waste press-waters were led into the apparatus again during the trial for use again in the extraction, this being done without loss and without fermentation. Juices having a density of 14·5° Brix were obtained when working hot Although the juices were not properly treated in the strainers for the separation of their pulp content (this apparatus being out of order), yet the juices obtained after defecation and subsequently were easily worked, 2 per cent. of lime sufficing.

MECHANISM OF FILTRATION *E. A Alliott, E. C. Williams, and J. W. Hinchley. The Chemical Trade Journal, 1925, 76, No. 1968, 169-170.*

Mr ALLIOTT in the course of a discussion on this subject at a recent meeting of the Institution of Chemical Engineers, London, said that it was difficult to get consistent results in filter-press work. Particles are never rigid, consisting of all sorts of conglomerates with odd points and corners, so that when a little extra pressure is applied some of these break off and impart extra consolidation. Assistants in experimental work had to be drilled into the knowledge of the fact that pressure had to be applied very gently. Sometimes the practical man is apt to sneer at mathematical formulæ, but this is not altogether right. It helps to train one to realize how the various factors enter into the problem, and he would be glad of a formula which could be used with very little trouble. Prof. E. C. WILLIAMS, referring to Hatschek's view that the pressure of filtration does not affect the compactness of the cake, since the resultant pressure is the same in all directions, said he did not think that was quite the case; because, apart from the general pressure on the cake, there was the pressure (if one likes to call it so) or force tending to push the particles inwards due to the friction of the liquid pressing on the wall of the capillaries through which it flowed. Since the capillaries were pointing in all directions, the influence on individual particles must also be in all directions amongst themselves, and that, he considered, would tend to help the "jostling" or movement of particles within the cake which enabled them to take up a more stable position of equilibrium. He believed that the view he had put forward, of the particles being "jostled" in the filter-press, and so given a gyratory or vibratory motion which enabled them to take up a more staple position, was perhaps a better explanation. PROF. J. W. HINCHLEY (Chairman) also remarked that it was extraordinarily difficult to obtain consistent results in filtration experiments. He likewise considered that Hatschek's contention with regard to precipitates was not correct, although vacuum experiments would seem to support it. At the Imperial College, one of the experimental problems was to determine the laws of filtration of calcium carbonate precipitate, and washing, at different pressures. If it were filtered at 5 lb , and washed, there was a certain law as to the rate of filtration, but if the pressure of washing were increased to about 60 lb., the cake would break down. If one went back to the low pressures, it would be found that the previous law had gone, and that there was a different law entirely. But even that was not quite the same as if one filtered at 60 lb and washed at 5 lb. up to 60 lb. Thus, there was still room for doubt, and they must not run away with the notion that they had proved anything with regard to Hatschek's law.

PRODUCTION OF DECOLORIZING CARBON FROM PAPER PULP WASTE LIQUORS. *R. H. McKee aud P. M. Horton. Chemical and Metallurgical Engineering, 1924, 32, 56-59.*

What the authors call a "new class of activated carbons" can be prepared from the black-ash residue left after calcining the liquors from the soda process of paper pulp manufacture, and extracting the residue with water, an alkaline char being left. Such carbons can be used for removing metals (e g., gold or silver) from solution; they are structurally identical with ordinary decolorizing carbons, into which they can be converted by acid treatment, then becoming suitable for use in sugar manufacture. But this change is held not to be one of mere neutralization, as the original properties cannot be restored by washing with alkali to render it alkaline to the same extent as previously. Only by treatment with alkali at 850° C. can the original properties of the carbon be restored. This alkaline char remains suspended in water and acts like a colloid; at a definite pH (3·8) is flocculates and settles rapidly. At this pH it becomes electrically neutral, loses its power of adsorbing metals, and becomes what the authors term an "ordinary decolorizing carbon."

TABLES RELATING TO THE INFLUENCE OF JUICE PURITY ON THE QUANTITY OF MOLASSES. *G. H. Haldén. Sugar News, 1924, 5, No. 9, 460-462.*

Various tables have been developed from Noel Deerr's *sjm* formula, these being as follows: I, values for the sucrose in commercial sugar, per cent. sucrose in syrup, for syrup purities from 60–92°, and molasses purities from 35–43°, purity of sugar remaining at 97·5°, these values being denoted by *A*. Table II, sucrose in final molasses, per cent. sucrose in syrup, that is 100—A = B. Table III, sucrose in final molasses, per cent. sucrose in the commercial sugar, that is values of 100 B/A = C. Table IV, giving kg. of final molasses per ton of commercial sugar, that is, values of C × 10 × *Ss*/*Sm* = D, in which *Ss* is sucrose per cent. commercial sugar = 96·75 ; *Sm* sucrose per cent final molasses ; and the final molasses has a Brix of 96°. Table V, giving U. S. gallons of final molasses per ton of commercial sugar, that is values of D/W, in which W = 5·5815 kilos per gallon.

SOURCES OF ERROR INVOLVED IN THE DETERMINATION OF INVERT SUGAR (REDUCING SUGARS). *M. A. H. van den Hout, P. A. Neeteson, and A. L. van Scherpenburg. Chemisch Weekblad, 1924, 21, 578–582.*

Various sources of error in the modification of Fehling's process in which the reduced copper is determined by the iodide method are discussed, and supported by the results of experiments, these sources of error being : Reduction by the sucrose present ; previous history of the flasks employed ; the hydrogen-ion concentration of the distilled water used ; the time of cooling after boiling ; the amount of KI added ; the time elapsing after acidification before titration ; and the presence of foreign salts, all being some importance.

J. P. O.

Review of Recent Patents.[1]

UNITED STATES.

CLARIFICATION OF SYRUPS (ESPECIALLY REFINERY LIQUORS). *Ernest J. Sweetland*, of Montclair, New Jersey (assignor to *United Filters Corporation*, of New York, N. Y., U.S.A. *1,510,809*. October 7th, 1924.

A process of continuous clarification, which may be practised by the employment of apparatus of a simple and inexpensive character, and at the same time will require a minimum amount of labour in handling is described. Impurities are caused to rise to the surface of the liquor, where they are subsequently removed, the clarified liquid being drawn off from beneath, all of which can be performed in uninterrupted manner. To effect the upward raising of the impurities to the top of the liquor, compressed air is passed through fabric or other suitable media possessing fines pores or minute interstices capable of breaking up the air into a correspondingly large number of extremely minute columns, so that the liquor covering the surface of the medium will cause the air to emerge in the form of correspondingly small bubbles The action of these bubbles passing through and commingling with the liquor containing the flocculent precipitate is that they become attached to the particles of impurities and through their balloon-like action, gravity is overcome and the particles are carried to the top of the liquor for their removal. Oil may be added to the sugar before it is melted so that the particles of impurities will be pre-coated before being brought into contact with the water used to dissolve the sugar. Addition of such oil will facilitate the clarification of the liquor and make more rapid the operation of the process.

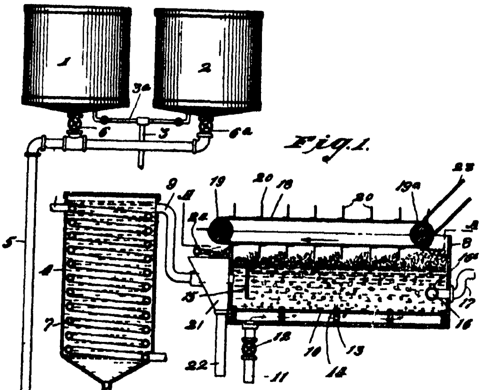

Fig. 1.

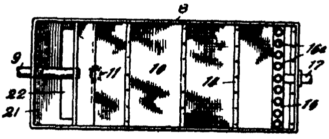

Fig. 2.

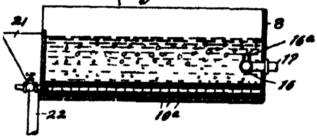

Fig. 3

Referring in detail to Figs. 1 and 2, one may employ one or more tanks *1* and *2* as containers for the raw syrup, which has been treated with a defecating agent (such as lime and phosphoric acid) To cause a thorough mixture of these ingredients, one admits compressed air through the pipe *3*, leading from a suitable source of supply and branch pipes *3a* leading to the respective tanks. In lieu of the compressed air, mechanical means may be employed for the purpose. Preferably situated below these tanks, a heating tank *4* is arranged communicating with the tanks *1* and *2*, by means of the pipe *5*, suitable valves *6* and *6a* being interposed in the pipe line to control the feed of the syrup. The heating tank *4* is provided with a steam coil *7*, but, obviously, any other heating arrangement may be used for the purpose of the invention. After the treated syrup has passed from the storage tank *1* or *2* to the tank *7*, where it is heated and reduced to a high state of fluidity, it then passes to a clarifying tank *8*, the pipe *9* affording communication thereto. This clarifying tank is preferably rectangular in form and is provided with a porous partition *10*, which may consist of several layers of heavy canvas, porous stone, wood blocks *10a* (see Fig. 3), or any other medium provided with minute openings or interstices which will serve to break up and distribute the air or gas which may be employed in the clarifying process. This air or gas is admitted through a pipe *11*, which is suitably valve-controlled at *12*. The porous partition *10* is supported above the bottom of the tank *11* by perforated supporting members *13* held down by the fastening members *14*. It will be apparent that as the compressed air is admitted through the pipe *11*, it will become diffused throughout the entire space between the bottom of the tank and the porous partition Its egress will be in small streams which will be broken up into the minute bubbles above referred to. In order to cause a more even distribution of the liquor, as it is admitted to the clarifying tank *11* through the pipe *9*, a baffle plate *15* is positioned immediately in front of the discharge orifice. The air bubbles in rising to the surface of the liquor in the clarifying tank *11* become attached to the particles of flocculent precipitate and attached impurities, and carry them upwardly to aggregate upon the surface of the liquor forming as it were a froth or foam The clarified liquid is continuously discharged through a perforated pipe *16*, having receiving orifices *16a* positioned in the wall of the tank and connected with a curved exterior discharge pipe *17*, the connection between the two pipes being of a swivel nature so that the elevation of the discharge opening may be varied to control the level of the liquid within the tank. It will be understood that the flow of the liquid from the supply tanks *1* and *2* through the heating tank *4* and the clarifying tank *8* is continuous and the parts are so proportioned that the liquor passing from the point of ingress to the point of egress in the clarifying tank will be sufficiently acted upon by the air bubbles to be thoroughly treated so that when it is discharged from the pipe *17*, it will be completely cleared of all impurities. To remove the separated impurities which are now floating upon the surface of the liquid in the form of foam, one provides a skimming arrangement in the form of a continuously operated belt member *18* playing over suitable rollers *19* and *19a*, supported in a suitable manner above the clarifying tank Fastened to the belt *18* are a plurality of flights or fins *20*, which are drawn across the top surface of the liquid and function to scrape or push (as it were) the foam containing the impurities to one end of the tank where it can be discharged into a hopper *21* communicating with a discharge outlet *22* The belt or conveyor *20* operates slowly and is driven by a suitable power belt *23* operating over one end of the roller *19a*. To facilitate the discharge of the foam and the impurities which it carries, one provides spray pipe *24* supplying a number of small streams of water which are discharged into foam as it flows into the hopper.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following :—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C 2 (price, 1s. each). *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

AUTOMATIC DEVICE FOR LIMING JUICE[1]. *Charles J. Fleener*, of Waipahu, T H. (assignor to *Ernest W. Greene and W. Richardson*, both of Waipahu, T.H. *1 517,499*. December 2nd, 1924.

Referring to the drawings, *A* indicates a closed conduit running from the mill, and adapted to contain the raw juices which are drawn therethrough by means of a suction pump *B*. A reservoir is mounted adjacent the conduit *A*, and adapted to contain properly purified and standardized milk-of-lime, and a pump *D* is positioned near the bottom of the tank *C*, in communication with the lower portion thereof, and adapted to draw off a constant supply of milk, and deliver it to a pipe *1*, leading upwardly alongside of the reservoir *C* and emptying into a tank *E*. Adjacent to the tank *E*, and mounted somewhat below the latter, is a receiver *F*, provided with a transversely-extending, centrally located partition *F'* having downwardly diverging walls *2* and *3*, secured to the floor of the receiver *F*, and forming a triangle having its apex just below the level of the top of the side walls of the receiver. It will be noted, therefore, that the partition *F'* serves to divide the receiver *F* into compartments *4* and *5*. A pipe *6* leads through the bottom of the compartment *5*, and empties into the reservoir *C*, and another pipe *7* leads from the compartment *4*, and is tapped into the conduit *A* carrying the raw juices, as shown in Fig. 1. The tank *E* is carried by legs *8*, *8*, and is slidable upon supporting members *9*, *9*. A standard *10* is connected to the bottom of the tank, and carries a block *11* provided on each side with longitudinally-extending grooves adapted for the reception of inwardly extending flanges *12*, *12*, formed on the connections between the members *9*, *9* on each side. Secured to the block *11* is an externally screw-threaded shaft *13*, which passes through an internally screw-threaded aperture in a casting *14*, secured between the legs *8*, *8*, as shown in Fig. 4. At its outer end, the shaft *13* carries a hand-wheel *15*, whereby the shaft may be rotated to longitudinally move the tank *E*, as will be understood The tank *E* carries an overflow lip *16*, on the side adjacent the receiver *F*, as shown in Figs. 1, 2 and 3, said lip being somewhat above the top edge of the receiver *F*, and extending thereover. As shown in Figs. 2 and 3, the lip *16* extends over and projects upon each side of the top or apex of the triangularly formed partition *F'*, and the overflow from said lip will obviously cause some of the milk to enter the compartment *4*, and the remainder to fall into the compartment *5*, the proportion of such overflow being divided between the compartments in accordance with the position of the tank *E*, as will be understood. The milk which has been delivered to the tank *E* by the pipe *1*, under the impulse of pump *D*, overflows into the compartments *4* and *5*, as described, all the milk delivered to the compartment *5* freely running downwardly and back into the reservoir *C*, through the pipe *6*. The milk which passes into the compartment *4*, however, passes downwardly through the pipe *7*, and enters the conduit *A*, where it immediately passes with the juice to the pump *B*, and is there effectually mixed with juice. A pipe *17* is tapped into the conduit *A*, on the pressure side of the pump *B*, and said pipe leads upwardly and is provided with a downwardly turned outlet *18*, emptying into the compartment *4*. It is obvious that the pressure of the pump *B* will serve to maintain a constant stream of mixed juice and milk, passing through pipe *17* and out of outlet *18*, and, since the juices and milk have been properly mixed in the pump *B*, immediately prior to egress from the conduit *A*, the mixture passing through the outlet *18* is representative of the entire mixture which is delivered at the terminal of the conduit *A*. The outlet *18* of the pipe *17* is disposed laterally of the partition *2* of the compartment *4*, and spaced from the bottom of the compartment, and the steady stream of mixture passing from the outlet is at all times within reach of the operator, who may at any time easily

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[1] Some particulars of this apparatus have already been published. See *I.S.J.*, 1924, 91.

Fig 1

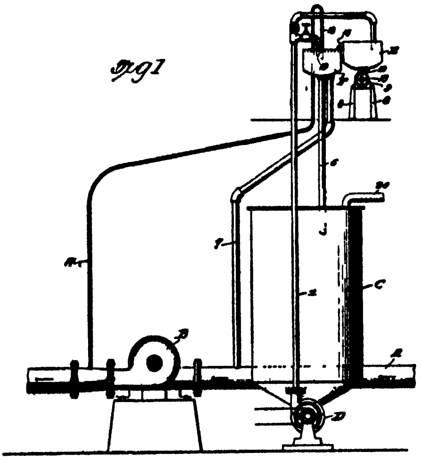


Fig 2

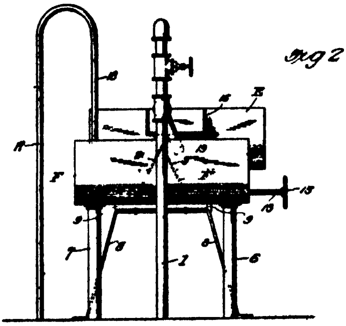
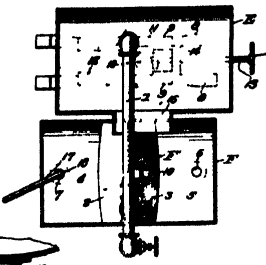
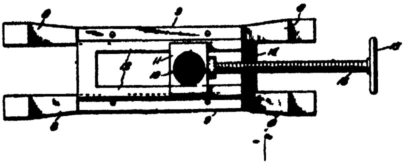
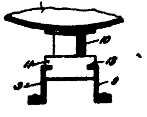


Fig 3







obtain a small quantity and subject it to any desired test. If the requisite amount of milk is not being added to the juices through pipe *7*, the operator actuates the wheel *15* to move the tank *E* to the left, Fig. 3, causing the lip *16* to deliver more milk to the compartment *4*. If the test shows too great a proportion of milk, the tank *E* is moved to the right, resulting in a reduced quantity being delivered into the compartment *4*, as will be clearly understood Pump *D* takes the milk from the bottom of the reservoir *C*, thereby withdrawing the portion of milk with the strongest lime content, and delivering it with some considerable force, under the action of the pump, to the tank *E*, which force causes a continuous agitation of all the milk in said tank, retaining the lime in suspension. From the compartment *5* of the receiver *F*, the milk gravitates through the pipe *6* to the *C*, assisting agitation therein. In addition a branch pipe *19* is provided, leading off from the pipe *1*, and terminating in an angularly disposed outlet which discharges into the compartment *5*, as illustrated in Fig. 2. This discharge of milk from pipe *19* materially assists in the maintenance of the necessary agitation so that the lime will be held in suspension.

From the foregoing the operation of my device should be perfectly clear. The reservoir *C*, having at first been filled with a standard quality of milk, by any means such as a pipe *20*, leading from a source not shown, the pump *D* is placed in operation and constantly delivers a steady supply of the milk to the tank *E* and to the compartment *5* of of the receiver *F*, as explained, all unused portions of the milk automatically returning to the reservoir *C*. By means of the lip or spout *16*, a certain proportion of the milk enters the compartment *4* of the receiver *F*, and passes therefrom through the pipe *7*, to the raw juices in the conduit *A*, and is mixed with said juices by the pump *B*. The pump *B* is at all times forcing a small supply of mixed juices and milk through pipe *17* and delivering it past the outlet *18* to the compartment *4* of the receiver *E*, all portions of the mixture not used in the test for lime content passing back to the conduit *A* by means of the pipe 7. By means of the sliding tank *E*, as described, the operator may control the position of the overflow lip *16*, to accurately deliver the required amount of milk to the compartment *4*, and thence to the conduit *A*, which supply will of course remain constant so long as the pump *D* is in operation, or until the tank *E* is again shifted.

EVAPORATOR FEED AND OVERFLOW REGULATOR. *Joseph Price* (assignor to *The Griscom Russell Co.*, of New York, U.S.A.). *1,522,907*. January 13th, 1925.

Claim 1.—In an apparatus of the class described, the combination of a reservoir, an intake port, a discharge port, and means controlled by the flow through the intake port for regulating the discharge.

CONTINUOUS EXTRACTION OF JUICE FROM BEETROOT, ETC.[1] *André Olier*, of Terrance, France *1,523,277*. January 13th, 1925.

Claim 1 —An apparatus for the continuous extraction of sugar from raw materials embodying a sinuous fluid-tight conduit comprising a plurality of vertical adjacent tubes connected in series by means of bends, a pulley in each of said bends, an endless conveyor adapted to feed the material to be treated through said sinuous conduit and passing over said pulleys, and means for imparting a rotary motion to said pulleys.

CZECHO-SLOVAKIA.

DECOLORIZING CARBON, INCREASING ITS POROSITY, *Rudolf Adler*. *3800*; of *1922*. August 19th, 1922; published June 15th, 1924.

Carbon, of any mode of production or origin, is treated at a temperature over 500°C. by passing over it for a long time a mixture consisting of oxygen and one or several gases or steam inhibiting combustion, the oxygen being kept at so low a content that the combustion of the particles of carbon caused by it only takes place after the thorough penetration of the skeleton of the carbon with the gas or gaseous mixture and without any apparent burning.

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[1] *I.S.J.*, 1923, 51, 665.

UNITED KINGDOM.

Precipitation of Tricalcium Saccharate in the Extraction of Sugar from Beet Molasses. *Carl Steffen*, Jr., of Vienna, Austria. *228,741.* April 1st, 1924. (One figure; five claims.)

In operating Steffen's process of extracting sugar from beet molasses, the formation of scum is a great disadvantage, because when the caustic lime falls on a frothy surface it is not entirely hydrated, the formation of the saccharate being thus delayed. In carrying out the invention having as its object the provision of a scumless surface, the usual apparatus consisting of a collecting container and a cooling vessel, connected together at their lower ends by a pipe in which a pump is inserted, is used. This apparatus may so be operated as to exclude any admission of air to the solution of molasses undergoing treatment, thus entirely preventing the formation of scum. Actually the process consists in maintaining the solution in the collecting container at a sufficiently high level such that if, owing to the natural variations of the pumping action, the pressure head is raised or lowered and accordingly different quantities of liquid pass from this container to the other vessel, an equalizing action is produced by the variation of the pressure head between the quantity of liquid delivered by the pump and the quantity leaving the one vessel so that the admission of liquid into the other vessel always remains below the level of the liquid in this vessel. An example of the apparatus for carrying out this invention is described and illustrated, it may be constructed in several different modifications

Decolorizing Carbon Manufacture. *C. G. Schwalbe*, of Everswalde, Germany. *228,512.* January 8th, 1925; convention date, January 30th, 1924.

Carbon suitable both as a fuel and for adsorbent purposes is obtained by carbonizing waste sulphite cellulose lye in the presence of a substance having a large surface development such as adsorption carbon, clay or kieselguhr, possibly together with a small quantity of an acid. According to an example, adsorption carbon which may be obtained by carbonizing wood chips, bark or the like with magnesium chloride solutions is mixed with sulphite cellulose lye previously concentrated by evaporation and a small quantity of hydrochloric acid added. The resulting pasty mass is heated in an air-tight vessel to a temperature below 200°C., preferably 180°C. at a pressure not exceeding 10 atmospheres. Water, methyl alcohol and sulphur dioxide are distilled off and a carbon having adsorbent properties remains. A portion of the latter may be left in the retort for treating further quantities of lye. When finely powdered materials of large surface area are employed they are maintained suspended in the lye by movement of the retort, or stirrers are provided therein.

Steam Generator. *J. Ruths*, of Djursholm, Sweden. *227,844.* January 14th, 1925; Convention date, January 14th, 1924.

A steam generating coil is placed in the vapour space of a vessel containing hot liquid and connected to the liquid and vapour spaces of a boiler in which the liquid is heated. Several boilers, which may be of the water-tube type, may be connected to a single vessel containing the steam generating coil. The return of liquid to the boiler may be assisted by a pump. Liquid may be drawn from the bottom of the vessel and forced into the vapour space in contact with the steam generating coil. Cast-iron or other heat storing solid material may be placed in the liquid in the vessel.

Manufacture of Crystalline Dextrose (Glucose).[1] *Corn Products Refining Co.*, of 17, Battery Place, New York, U.S.A. *227,140.* July 12th, 1923.

Relates to processes of producing crystalline dextrose (glucose) consisting almost entirely of hydrated or anhydrous crystals as may be required. For this purpose the concentrated liquor is cooled down to a temperature suitable to the production of crystals of the type required, seeded with crystals of that type, agitated while crystallization takes place, and separated from the crystals in a centrifugal. For producing hydrated crystals the liquor is concentrated to about 40° Baumé and crystallization takes place at between 95 and 105°F.; whilst for producing anhydrous crystals the liquor is concentrated to a slightly greater density from 38—45° Baumé, but for average operations about 41° Baumé, and crystallized at a temperature of 110 to 135° according to the density. When a considerable quantity of anhydrous crystals has been produced the temperature may be allowed to fall lower. A system of operations for producing sugar in two or more stages is described.

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[1] See U.S. Patent, 1,471,347; *I.S.J.*, 1924, 285.

Determination of the Specific Gravity of Pasty Substances. *Cirio Co., Ltd.*, of 23, Eastcheap, London. *228,050.* May 13th, 1924.

Apparatus is described, resembling a hydrometer, the bulb of which carries a vessel into which is loaded the substance under examination, its density being read from the stem when the instrument is floated in water.[1]

Colloidal Clarification, using Alginates. *A. J. Ravnestad*, of Fredrikstadt, Norway. *225,635.* September 11th, 1923

The liquid under treatment is treated with an alginate and with a solid or liquid substance or a gas, which will act mechanically to accelerate the separation of the suspended and coagulated matter. Where an electric charge tends to keep the particles in suspension, the accelerating agent may be chosen so as to give a neutralizing electric charge. Gas may be introduced by means of an emulsifier, by pressure, by electrolysis or by chemical reaction, as for instance the development of carbonic acid.

GERMANY.

Active (Decolorizing) Carbon Production. (*A*) *Farbenfabrik vorm. Friedr. Bayer & Co.*, of Leverkusen b. Koln a. Rh., Germany. *374,208.* September 7th, 1921. (*B*) *Badische Soda u. Anilin Fabrik* (assignees of *A. Mittasch and J. Jannek*). *405,321* May 26th, 1920. (*C*) *Mineral-Chemische Ges. m. b. H.* *405,377.* November 18th, 1922.

(*A*) In order to prevent or diminish the inflammability of decolorizing carbon, small amounts of non-volatile or difficultly volatile acids (e.g., phosphoric) are added. (*B*) Carbonaceous material for use in the production of active (decolorizing) carbon is treated with small amounts of nitrates of alkali metals (including those of ammonium), or of alkaline earth metals (including magnesium). (*C*) Organic materials after having been impregnated with a solution of potassium acetate are carbonized, and the residue remaining after carbonization is treated with hydrochloric acid (dilute).

Removal of Sulphur Dioxide from Fruit and other Juices. *E. Spitalsky.* *400.249.* March 9th, 1923.

Juices (and other liquids) containing SO_2 are treated at a suitable temperature with a current of non-oxidising gas, such as nitrogen or carbon dioxide. After passing the gases through absorbent to remove the SO_2, the gas is used again in the process.

Recovery of Sugar from Cane Molasses, using Baryta. *Camille Deguide*, of Enghien, France. *395,563.* November 19th, 1922. **Recovery of Ammonia from Beet Residues or from Molasses.** *Gaston Philippe Guignard*, of Melun, France. *374,776.* October 5th, 1921.

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[1] The inventor states that his apparatus is very suitable for the rapid determination of the water content of massecuites, molasses, and other dense products. He calls it an "aero-picnometer."

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	ONE MONTH ENDING MARCH 31ST.		THREE MONTHS ENDING MARCH 31ST.	
UNREFINED SUGARS.	1924. Tons.	1925. Tons.	1924 Tons.	1925. Tons.
Poland	4,729	176	19,301	7,877
Germany	....	....	....	1,894
Netherlands	....	....	....	....
France	....	. ..	....	....
Czecho-Slovakia	1,904	....	14,310	494
Java	....	....	2	1,886
Philippine Islands		....	....	....
Cuba	70,964	76,204	88,882	122,221
Dutch Guiana	....	....	...	....
Hayti and San Domingo	10,823	25,826	21,558	37,728
Mexico	...	....	....	....
Peru	9,910	7,286	31,699	34,316
Brazil	....	....	21,477	6,472
Mauritius	8,733	....	82,071	300
British India	...	....	...	. ..
Straits Settlements	....	.	....	....
British West Indies, British Guiana & British Honduras	4,564	3,778	15,401	7,128
Other Countries	7,164	8,309	21,329	33,778
Total Raw Sugars	**118,792**	**121,580**	**316,029**	**254,096**
REFINED SUGARS.				
Germany	....	157	126	5,158
Netherlands	15,135	17,094	47,075	50,937
Belgium	2,236	1,079	18,702	7,287
France	....	....		....
Poland	1,978	2,376	13,589	14,575
Czecho-Slovakia	2,027	22,156	21,879	81,326
Java	....	....	....	....
United States of America	2,621	4,694	3,471	5,491
Canada	4,107	7,736	5,064	10,025
Other Countries	532	53	1,549	273
Total Refined Sugars	**28,638**	**55,345**	**111,456**	**175,074**
Molasses	16,578	5,374	39,394	27,526
Total Imports	**164,008**	**182,299**	**466,879**	**456,696**

EXPORTS.

BRITISH REFINED SUGARS.	Tons.	Tons.	Tons	Tons.
Denmark	71	169	121	215
Netherlands	29	17	110	58
Irish Free State	3,454	3,048	11,634	10,036
Channel Islands	62	78	264	190
Canada	....	....	....	..
Other Countries	570	352	1,718	1,229
	4,186	3,659	13,847	11,728
FOREIGN & COLONIAL SUGARS.				
Refined and Candy	129	111	356	442
Unrefined	77	54	4,750	140
Various Mixed in Bond	....	....	....	....
Molasses	269	77	405	139
Total Exports	**4,661**	**3,901**	**19,358**	**12,449**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1925. Tons.		1924 Tons.
Total Receipts, January 1st to April 1st..	924,102	..	938,101
Deliveries ,, ,, ...	913,517	..	926,353
Meltings by Refiners ,, ,, ...	820,430	..	793,030
Exports of Refined ,, ,, ...	13,500	..	10,600
Importers' Stocks, April 1st	10,585	..	12,542
Total Stocks, April 1st	127,529	..	167,424
	1924.		1923.
Total Consumption for twelve months	4,854,479	..	4,780,684

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1922-1923, 1923-1924, AND 1924-1925.

(Tons of 2,240 lbs.)	1922-23 Tons		1923-24 Tons		1924-25. Tons
Exports	886,195	..	883,915	..	940,585
Stocks	460,009	..	437,958	..	623,658
	1,346,204		1,321,873		1,564,243
Local Consumption	17,000	..	17,000		23,000
Receipts at Port to February 28th	1,363,204		1,338,873		1,587,243

Havana, February 28th, 1925 J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR THREE MONTHS ENDING MARCH 31ST, 1923, 1924, AND 1925.

	IMPORTS				EXPORTS (Foreign)				
	1923. Tons	1924 Tons	1925 Tons.		1923. Tons		1924 Tons		1925. Tons
Refined.. ..	70,059	111,456	175,074	Refined	742	.	356	..	442
Raw	271,884	316,029	254,096	Raw . .	7,292	.	4,750		140
Molasses ..	46,127	39,394	27,526	Molasses . .	980		405		139
	388,070	466,879	456,696		9,014		5,511		721

	HOME CONSUMPTION				
	1923 Tons		1924 Tons		1925. Tons
Refined	73,632		84 862	.	184,701
Refined (in Bond) in the United Kingdom	218,592	..	217,752		170,153
Raw	29,918		19,652		23,024
Total of Sugar	322,142		322,266		377,878
Molasses	2,013		2,406	.	1,431
Molasses, manufactured (in Bond) in United Kingdom	14,460	.	15,216	..	15,268
	338,615		339,888		394,577

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT MARCH 31ST.

	1922 Tons		1923. Tons		1924. Tons.
Refined in Bond	68,900	..	56,800		36,750
Foreign Refined	29,550	..	48,000	..	27 350
,, Unrefined..	185,600	..	149,150	.	122,950
	284,050		253,950		187,050

United Kingdom Monthly Sugar Report.

Our last report was dated the 10th March, 1925.

The market has been generally a declining one throughout the period under review and has lost the major portion of the advance of 9d. to 1s. per cwt. experienced last month.

Business on the terminal market was rather on a restricted scale and speculation was conspicuous by its absence. Tenders of March were only 3500 tons, and the price of this month kept well up to the close and was finally liquidated at 18s. 4½d. May fluctuated considerably from 18s 6d to 18s 9¾d. to 18s. 6d. to 18s 7½d. to 17s. 9d. A large business has been done in August from 18s. 9d to 18s. 10½d. to 18s. 7½d. to 18s 8¼d. to 18s. New crop has steadily declined from 18s. 7½d. to 17s. 11¼d. The latest prices are May 17s 9¾d., August 18s , and October/December 17s. 11¼d.

Trading in actual sugars has not been so good and the offers of all kinds of Refined Sugar exceeded the demand. Fine Granulated on the spot advanced from 31s. 10½d. to 32s. 3d., but finally declined to 31s 5¼d. duty paid less 1½ per cent. There is now practically no lower grade Granulated or Crystals offering on the spot. Home Grown Sugar is now entirely sold out and no quotations are being made for this class of sugar. A small business continues to be transacted in White Javas but at the higher level of prices it was difficult to find buyers; May/June shipment fell from 18s. 4½d. to 17s. 10½d. c.i f., June/July from 18s. 1½d. to 17s. 9d. c.i f., and July/August from 18s. to 17s. 4½d. c i.f. Canadian and American Granulated have been pressed for sale latterly and a fair business has been put through at 18s. 9d. to 18s. 6d c.i.f. for April/May shipment, and 18s. 9d to 18s. 7½d. for shipment up to July. Czecho Granulated for ready and April/May shipment was sold from 18s. 9d. to 18s. 4½d. f.o.b., and Dutch Granulated also sold from 18s. 9d. to 18s. 4½d. Russia has again been in the market as a buyer and has bought a considerable quantity of ready and prompt Granulated; these purchases are variously estimated from 30,000 to 50,000 tons. Forward months have not attracted much attention but a moderate business has taken place at about 1½d. premium over the ready price. Germany, owing to the demand in her own country, has remained out of the market and the prices ruling in that country are above the export parity. Offers of Belgian Crystals and Granulated have been few, and the prices asked do not allow these sugars to compete with other makes.

The British refiners did not purchase any Cubans at 15s., but when the market receded they bought again from 14s. 7½d. to 13s. 7½d., and there are now sellers at 13s. 9d. with buyers at 13s. 6d. The Continent also took one or two cargoes round about 14s.

The United Kingdom Refiners at first experienced a good demand for their sugars and on March 11th they advanced all prices by 6d. per cwt. At this level, however, the demand fell off and with the easier raw quotations prices were lowered again by 6d per cwt. on the 27th March Again on the 31st March prices were again reduced by 6d. per cwt. The latest quotations are No. 1. Cubes 36s 6d., London Granulated 32s 4½d

A large business has been done in America and the Refiners have bought large quantities of Cubas, Porto Ricos, and Philippines from 3 1/16ths down to 2 13/16ths c.i.f New York, and it was rumoured that 2¾ has been done for an isolated lot.

The Cuban crop is making good progress. The weather has been good for harvesting but one or two Centrals have experienced labour troubles which generally takes place when prices are low. The yield is reported to be improving and the receipts to date are 260,000 tons more than last year. It is also reported that the production to date is 350,000 tons in excess of last year.

With regard to the European Beet sowings, Mr. F. O. Licht has compiled a table (which must not be taken as a reliable estimate) of the future Beet area:—

	1925-26. Hectares	1924-5 Hectares.
Germany	360,000	351,371
Czecho Slovakia.	290,000	302,588
France	165,000	195,615
Holland	65,000	71,065
Belgium	72,500	80,591
Sweden	39,800	41,130
Denmark	38,000	37,400
Poland	155,000	168,348
Hungary	70,000	74,414

	1925-26. Hectares.	1924-5. Hectares.
Austria	18,500	18,610
Roumania	50,000	58,500
Jugoslavia	40,000	55,000
Italy	80,000	136,300
Russia	380,000	343.182
Other countries..	122,000	143,700
Total ..	1,965,800	2,077,814

21, Mincing Lane,
London, E.C. 3.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 317. MAY, 1925. Vol. XXVII.

Notes and Comments.

The Budget.

On April 28th Mr. WINSTON CHURCHILL (as Chancellor of the Exchequer) introduced in the House of Commons his first Budget. This event had been awaited with considerable interest, as it was hoped it would mark a definite turning-point in the pressure of taxation. A reduction in the Income Tax was confidently predicted, and the only doubt was whether the remission would amount to more than 6d. in the £. Steps to restore the gold standard with a view to stabilizing international exchange were also expected. Finally, it was an open secret that Imperial Preference would be restored on the lines of the resolutions of the Imperial Conference held in this country in October, 1923.

Actually the Budget statement was one of fewer changes than we have seen for some years past. Very few of the existing taxes were altered, and "penny postage," on which the trading community had set its heart, was not even referred to. But the burdens of the income tax payer have been lightened, first by taking 6d. off the tax, and secondly by allowing an increased rebate for earned incomes, a deduction of one-sixth, instead of as hitherto of one-tenth, of that income being freed from tax up to a maximum of £250. Mr. CHURCHILL very briefly intimated that the incidence of Imperial Preference on certain articles would be altered, sugar for instance being now destined to receive a firm preference equal to one halfpenny per lb. when imported into this country. Most of his speech, however, was devoted to justifying the restoration of the gold standard, and to unfolding a new form of contributory insurance for workers which would include pensions for widows and old people.

At the time of writing discussion on the Budget proposals has not got to the Report Stage when more detailed discussion takes place in Parliament, so we can only this month record the bare but welcome announcement that sugar produced within the Empire is to receive a preference on entry into this country amounting to ½d. per lb. as compared with foreign sugar. This of course means, as we pointed out last month, that British cane sugar will have its preferential advantage increased from 1s. 11d. per cwt. to 4s. 3·3d., while foreign sugar remains subject to a Customs duty of 11s. 8d. per cwt. The preference is thus roughly 29 per cent. of the Customs duty. Furthermore, the Government intend to stabilize this preference (as far as lies in their power) for a period of ten years, providing of course that the duty on foreign sugar does not fall below that figure of 4s. 3·3d. per cwt.

The present Government cannot of course guarantee that a future Labour Government will honour this agreement; and if Mr. SNOWDEN, the late Chancellor of the Exchequer, had it his own way, we fear he would find ample doctrinaire reasons for terminating it. But not all Labour leaders take this narrow view of our responsibilities towards overseas Dominions and Colonies. Mr. THOMAS, the late Colonial Secretary, is a striking instance of the contrary view to that of Mr. SNOWDEN. We therefore believe that providing the present Baldwin Government runs its full span of office, opinion in this country amongst all classes of politicians will by then have sufficiently hardened in favour of the Imperial idea, to ensure that no political *volte face* will be inflicted on Colonial interests. The Empire sugar producers are therefore now offered a measure of stability extending over a considerable number of years such as they have not had for some generations past, and it is sincerely to be hoped that they will make the most of their opportunity, and that the weather—always an important factor, especially in the West Indies—will be kind to them in their increased endeavours. Capital should now show no more hesitation in supporting schemes for modernizing or extending sugar factories; and we ought to be spared experiences, such as occurred a year ago under the Labour regime, of sugar company flotations being spoilt by fiscal changes and shied at by the investing public.

The new scale of preference is intended by the Government to start not immediately on the Budget resolutions being disclosed, as is generally the rule, but two months thereafter, viz., on July 1st. This seems a pity; we agree with the *Produce Markets Review* that the Empire producer might very well have had his boon at once. Repeated assurances of at least semi-official type have been made ever since the General Election last October that the old rate of preference would be restored, so it is not a matter for wonder that stocks of preferential sugar, both refining and grocery, have been lately accumulating in bond, and the present time represents the height of the importing season from the West Indies, the part of the Empire that most needs the preference. Unless, then, a new and nearer date is conceded in Parliament during the next week or two, the cane sugar markets, in the opinion of the *Review* above referred to, will remain unsettled for two months more with some important holders reluctant to sell, in the hope that the mistake will be remedied quickly.

Production and Consumption.

An interesting leading article in a recent number of *Facts about Sugar* discusses the remarkable increase in the world's sugar supplies during the present industrial year, and its effect on prices and on consumption. Our contemporary points out that this season has proved an exception to the rule that heavier tonnages of cane and beets are usually accompanied by yields below the average; actually, high acreage yields and high quality have coincided in the majority of important sugar growing countries, and the result is an increase in the size of the world's sugar crop such as we have never had before. Original estimates have almost everywhere been exceeded, and the increase over the 1923-24 crop now amounts to 2¾ million long tons, or as much as the entire annual consumption of the world about the year 1870. This is equal to three times the normal increase in the world's yearly production.

Europe provides the greatest gain in output, a production of just over 5,000,000 tons in 1923-24 being this year raised to over 7,000,000 tons, a gain of nearly 40 per cent. The increase restores Europe to something like its pre-war position and is obviously not likely to be duplicated in any other single year. Cuba registers a gain of 16 per cent. over last season; Santo Domingo, 10 to 15 per cent.; the British West Indies, between 15 and 20 per cent.; Peru, 10 per cent.; Java, 11 per cent.; Mauritius, about 10 per cent.; the Philippines, 40 per cent.; and Australia, no less than 54 per cent.

But, in the opinion of our contemporary, the fact that production has increased so largely does not materially change the world supply situation for the year, but means that the quantity entering the international markets for sale is correspondingly increased. Distribution has been proceeding at a higher rate all round and stocks on hand in the various centres show only moderate increases as compared with the corresponding date last year. All this shows the remarkable capacity of the world population to absorb sugar, especially when prices tend to get lower. But though prices have been depressed by this additional supply of sugar, the decline has been less than might have been expected. Present indications suggest that the great bulk of the visible supply will be absorbed before the end of the year and that carry-over stocks will not be unwieldy, nor heavy enough to have a depressing effect upon the value of next crop sugars, which our contemporary opines will be determined on the basis of current demand and supply in 1925-26.

It may be added that the consumption of sugar in the United Kingdom shows an upward tendency; 1924 accounted for a consumption of 1,631,300 tons, which was about a hundred thousand tons more than in 1923, but did not touch the 1922 figures (1,666,859 tons). For the first quarter of this year, however, we have had a consumption of 394,577 tons, as compared with 339,888 in 1923, and 338,615 in 1922; and that in spite of the fact that imports of Colonial sugar have lately been at a minimum figure, in the hope that the Budget would bring in early revision of the preference. Continued bad trade and the unemployment resulting from it must necessarily have a deterring effect on the purchasing power of a large section of the population; but as 1924 was a bad fruit year in this country, a bountiful fruit harvest in 1925 is sure to have its effect in increasing the consumption of sugar later on in the year.

Wissington Beet Sugar Factory.

Reference was made briefly in our issue of October last (page 521) to a project for the establishment of a beet sugar factory at Wissington, in Suffolk. The scheme, we believe, hung fire for a while, and the personnel of the original promotion has undergone some change. But a factory is now being built by a company recently formed under the title of "British Sugar Manufacturers, Ltd.," one of the directors of which is Mr. W. A. Towler, a large local landowner. We understand that foreign interests are arranging the technical side of this factory; but the contract for the greater part of the sugar-making plant has been secured by Messrs. A. F. Craig & Co., Ltd., of Paisley. This includes a complete saturation plant, lime-kiln, filter-presses, vacuum pans, crystallizers, condensers, pumps, storage and other tanks, slice and pulp conveyors, etc. Since this factory is to be at work this autumn, Messrs. Craig & Co. have naturally a big task before them to complete the equipment in time; but, bar delay through strikes or other engineering troubles, we anticipate they will succeed in fulfilling their contract. The boiler plant, if we mistake not, will be of Babcock & Wilcox pattern.

Centrifugal Plant for the New Beet Sugar Factories.

We learn that Messrs. Pott, Cassels & Williamson have been successful in securing the order for centrifugal plant and accessories for no less than four of the new beet sugar factories projected in this country. For the Ely factory they are providing a battery of 48 in. electrically-driven centrifugals and a battery of 48 in. water-driven ones. For Bury St. Edmunds factory two batteries are being provided, both electrically-driven, but one set has 48 in. baskets and the other 42 in. Spalding will have a battery of 42 in. electrically-driven machines. Finally Wissington, the independent projection in Suffolk above referred to, is being provided with a battery of 42 in. electrically-driven machines.

Mr. J. R. Bovell, I.S.O. Retiring.

We learn that Mr. John R. Bovell was to retire from his position of Director of Agriculture in Barbados at the end of March We therefore take the opportunity of giving the following particulars of his career and his work on behalf of the West Indian sugar industry, as supplied us by a valued correspondent.

Mr. Bovell entered the Civil Service in Barbados in 1883 as Superintendent of Dodd's Reformatory and of the Botanical Station there situated. It was here that he started in 1884 his experiments with sugar cane seedlings which have been of so much value to the sugar world. Noël Deerr puts this date at 1889 and joins Harrison with Bovell in the inception of the work, but in 1884 Harrison was not in Barbados.

When on the recommendation of the Royal Commission for the West Indies the Imperial Department of Agriculture was created, with the then Dr. Daniel Morris as Commissioner, the latter recognizing Mr. Bovell's worth and ability appointed him to be in charge of the sugar cane experiments carried on by this department. On Sir Daniel Morris's retirement the Barbados Department of Agriculture was independently organized with Mr. Bovell as Director.

The history of agriculture in Barbados during the past forty years is in a large measure bound up with Mr. Bovell's activities. That the sugar industry there has been maintained in all its vigour in spite of years of drought and low prices is chiefly due to the cultivation of seedlings grown by Mr. Bovell to replace the Otaheite cane. This cane was of very luxuriant growth, but then as now very susceptible to fungus diseases. So great was the extent of the attack of root disease on this variety in the early nineties that the cane industry in Barbados would probably have had to be abandoned if Mr. Bovell had not been on the spot producing resistant varieties.

All the greater credit is due to him when it is remembered that he has carried on his work handicapped by the very small personnel of his department and the also very small appropriation allotted to his department during the past years, under £3000 per annum. This is a very small sum when the great benefit from his work is considered. In the 1922-23 report of the Department of Agriculture of Barbados it is stated that the monetary increase in that island due to the new varieties in comparison with the white Transparent (Cristalina) for the past eight years amounted to twenty million dollars. But Mr. Bovell's work has not been confined to Barbados. In 1910 he visited Guanica, P. R., as a consultant, and it was on his recommendation that the Experiment station of the Sugar Growers' Association at Rio Piedras was established. He was offered the first position of director there but remained true to Barbados. Mr. Bovell's work was recognised by the Imperial Government in 1910 by the bestowal on him of the Companionship of the Imperial Service Order. Surprise has often been expressed that since then he has not been recommended for a knighthood. On his advice also were established the sugar experiment stations in St. Croix and Guadeloupe. As late as last year he went to Barahona, R.D., on consultation work.

His Work in Porto Rico.

In Porto Rico his work is well known from the very many excellent varieties which have continuously flowed into that island from Barbados, culminating in the B.H. 10 (12) which some say is the best variety Porto Rico possesses. Now in the worst mosaic-infested district of the island is being tried out a strain of this cane which Mr. **Bovell** believes is immune to mosaic. He has not made his final tests and is being helped with them under the most trying conditions possible. In another couple of years it will be possibly to say whether this cane is really immune and if it is, it will be a worthy culmination of forty year's work.

The greatest rival in popularity of B.H. 10 (12) in Porto Rico is S C. 12 (4). This is also a Bovell cane as the original seed was given by Mr. **Bovell** to Dr. **Longfield Smith** when he was going to Santa Cruz to establish the Station there. This can be verified by consulting Longfield Smith's first annual report published in 1913.

Mr. **Bovell** will carry into his retirement the high regard of the whole cane sugar world which recognises the invaluable work which he has rendered it. Although he has reached his sixty-fifth year we do not suppose that his knowledge and experience will be entirely withdrawn from the sugar industry. For he is still strong and should be able still to do much consulting work.

Power Alcohol from Beet in the United Kingdom.

The British Power Alcohol Association, a body affiliated to the British Empire Producers' Association, has lately issued an appeal in favour of developing the production of power alcohol from sugar beet in this country. It points out that during the war the Germans ran most of their motor transport and aeroplanes on alcohol fuel, made to a large extent from sugar beet and other agricultural products. The Government has recently subsidized the growing of beet from sugar, and it is high time a serious attempt was made to secure a similar subsidy payable on the sugar content of beet grown for the production of power alcohol, which would in no way compete with the sugar factories for the reason that the distilleries would be established in smaller areas which could not possibly support a modern sugar factory.

Such distilleries capable of dealing with any quantities from 200 to 250 tons of beet per day would be quite feasible, whereas sugar factories to be economic require to deal through the short season with a minimum of 1000 to 1200 tons of beet daily. By establishing small distilleries within a short distance of the areas of supply, farmers can deliver the beets with their own horses and carts into hoppers at the factory, without handling, and return immediately with the pulp.

It is rightly claimed by agriculturists generally throughout the country that they have as great a right to the advantages of the subsidy for growing beet in limited areas as in the selected districts of Lincolnshire, Norfolk, Suffolk, and Cambridgeshire, advantages from which they are now precluded because of the large minimum required to start a sugar factory.

The present Minister for Agriculture has set out to secure the bringing back into cultivation of at least 1,000,000 acres out of the 5,000,000 acres which have gone back to grass. What better opportunity could he possibly have to secure this end than by encouraging a new industry that will benefit the farmers and the country as a whole? This, at any rate, is the view held by the British Power Alcohol Association.

It has no intention of selling power alcohol as a substitute for petrol, but, as is the case with benzol, for mixing, after simple and inexpensive treatment, with petrol in any quantities up to 50 per cent.; the special value of the mixture being increased efficiency, cleanliness of the engine, smoother pulling power, elimination of "knock," and many other advantages with which owners of motor vehicles are familiar.

The future of petrol is uncertain and by no means hopeful. Demand is rapidly overtaking supply, and leading experts predict that shortly American requirements will be so large as to enforce severe restriction of export.

There is no reason then why this country should submit to being dependent on other nations for those essential means of transport which are the life blood of industry when power alcohol can be made here at an economic price, very little in excess of the present exceptionally low price of petrol.

The American 1924-25 Beet Sugar Crop.

The United States domestic beet crop, according to the details published by Messrs. Willett & Gray, has ended with an outturn exceeding that of any previous campaign and in excess of Willett & Gray's last estimate by some 50,000 tons. The total production of sugar was 974,185 long tons, against 787,216 tons in 1923-24. The largest previous yield of sugar was in 1920-21, when the outturn was 969,419 tons.

The increased yields of sugar in the beets induced by the generally favourable weather conditions during the growing season were, with the increase in acreage, the material factors contributing to this large outturn. In the eastern growing areas the increased sugar content was particularly marked, offsetting some disappointing results in Utah and Idaho, where a drought made serious inroads on production and yield. Colorado continued to lead in production with an outturn of 324,600 tons of sugar, while Michigan with 147,700 tons was second. California was third, with 117,534 tons, and Nebraska fourth with 93,385 tons.

The total quantity of beets sliced was 6,344,516 tons, as compared with 5,892,536 tons during the previous campaign. There were 91 factories in operation, divided amongst 17 States, as compared with 89 operating in 1923-24. The average yield of sugar per acre has amounted to 1·19 tons, against 1·18 tons in 1923-24, 1·13 tons in 1922-23, 1·11 tons in 1921-22 and 1·15 tons in 1920-21.

The outlook for next campaign is, at the present time, fairly satisfactory, although it is probable that the acreage will be somewhat smaller than that of the season just closed. It is too early, however, for any certainty in the matter of estimates.

Will our subscribers and correspondents in Cuba and Porto Rico kindly bear in mind that the postage from those islands to the United Kingdom is 5 cents per letter and not 2 cents? We are led to make this observation from the fact that we are getting an increasing number of insufficiently stamped communications from those countries, with the inevitable post office surcharge. The postage from the United States to England is 2 cents, but this low rate does not apply from Porto Rico, though curiously enough it does from Hawaii, a much more distant U.S. territory; while Cuba's rate to England is on the usual "foreign" scale.

Fifty Years Ago.

From the "Sugar Cane," May, 1875.

R. H. BURTON discussed William Russell's maceration process,[1] as having considerable possibilities were it not for the unenterprising attitude of sugar manufacturers in the West Indies, where sugar was being made (it was stated) "with as little care and skill as it was nearly half a century ago"; and this writer argued as follows: "In cane sugar it is impossible to extract more than 65 per cent. of the juice with a three or even a five roller mill, hence the efforts to introduce the diffusion process which appears to have succeeded admirably upon a limited scale, but, I opine, will not be found practicable on estates of the magnitude of those in this colony (Demerara). I therefore reason by analogy that if we had two mills placed say 35 ft. distant from each other with a cistern of elliptical form connected with both mills, so as to contain a few inches in depth of cane juice, with a cane carrier of similar length held to the bottom of the cistern by light drums or cylinders, so as to force the canes under the juice as it passes from the first mill, which should simply mash the cane without crushing or breaking it, thus admitting a free absorption of the juice before it reaches the second mill, where the last particle of saccharine would be extracted, it is not necessary that the first mill should be large, it only being intended to prepare the cane for the second mill. By this arrangement you make the nearest approach—upon the most economical and inexpensive basis—to the diffusion process, and at the same time secure a full return for your labour. No matter, however, what percentage of juice is expressed, or the manner in which it is done, your interest prompts you to make it into the best possible grade of sugar."

Another article in this number of our predecessor was a eulogium on the Concretor, the invention of Mr. FRYER, the former Editor of the *Sugar Cane*. It was by Mr. WILLIAM CAMPBELL, of Muckle Nuek, Natal, and some of his remarks were as follows: "When taken out of the tayche for the vacuum pan, the juice shows about 220° F., but it is sometimes as high as 229° when taken off for the wetzels. Improvements are gradually coming into use in the construction of evaporating pans, the great object being to get the juice to pass through the great heat to which it is exposed as quickly as possible. Any heat above 140° F., it is said, injures the juice, and this injury is in proportion to the length of time it is exposed to it. Evaporating pans of the kind mentioned above are now made much shallower than formerly, and give greater heating surface in proportion to their capacity, so that the juice is passed through much sooner than in the old deep pans. The invention by Mr. FRYER of the Concretor was to lessen this evil, and it has succeeded to a remarkable extent in so doing. At first it was supposed that the Concretor could only be used for the purpose of making "concrete" (a sugar that must pass through the refiners' hands before it is used), but it is proved beyond doubt that it may be utilized as a substitute for the ordinary evaporating pans.[1] This has been done in other Colonies, and Mr. PLATT, of the Isipingo, has done it here. He obtains 4 ozs. of sugar per gallon more by using the Concretor trays in connection with the wetzel and centrifugal than by the ordinary open pans . . . ."

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[1] *I.S.J.*, 1925, 7, 72.

[1] Compare *I.S.J.*, 1925, 183.

Experimental Work in Queensland.

Now that the Australian sugar tract has set up a record of well over 400,000 tons of sugar, a whole series of new problems are emerging which will require solution. Reference may be made to two articles in last year's volume of this journal, for a discussion of this plexus of conflicting lines and interests[1]; but it is satisfactory to note that H. T. EASTERBY, in his latest Report[2] considers himself justified in assuming an optimistic outlook for the future. His point of view has undoubtedly been influenced by a notable pronouncement, which he quotes, on the part of the present Prime Minister of the Commonwealth; to wit, that the cane industry in Queensland is regarded as of national importance by the Government and will in future be assured of such treatment as will ensure its continuance. After all the "excursions and alarums" of the last few years, this is very good reading. The Prime Minister, after remarking that the sugar industry is the only means of bringing about a successful white settlement in the north, is reported to have concluded as follows : "I assure you that the Federal Government is conscious that it is imperative that the sugar industry should be carried on, not in the interests of the sugar growers, but for the maintenance of the White Australia ideal, and that is the basis on which the Commonwealth Government is approaching the problem. A dispassionate study of the history of sugar has done away with the Southern cry that preferential treatment is being given to sugar. I hope to be able to announce at the earliest possible date the Government's policy with regard to the great sugar question. It is most desirable that those engaged in the industry should know where they stand, and we as a Government appreciate that desire of the grower. We recognize the importance of this great vital national industry, and in any decision we will, according to our lights, give fair treatment to the industry, and such as will ensure its continuation ; such treatment as will ensure the settlement that is going on in the northern portions of the State."

The economics of the industry as laid out before us by EASTERBY may be briefly summarized by prefacing that, after some years of high prices paid for the sugar, this is the first year of the new £27 rate of payment per ton ; that the production during the year under report reached the surprising figure of 417,000 tons, the nearest approach to which was 307,719 in 1917 ; that, after satisfying all the requirements of the Commonwealth, a considerable amount will have to be exported ; that it is recognized that there will be an inevitable loss on every ton exported because of the prevailing high rate of payment to the white labour, but that the industry proposes to meet this loss by receiving only £26 per ton for its sugar. This resolve indicates a thoroughly healthy situation all round.

A large number of factors appear to have contributed to the high yield of the season. After the severest drought on record, which prevailed also in the early stages of the bumper crop, a magnificent growing season was experienced. A great increase in area under cane has taken place during the past few years, so that while in 1901 there were 112,031 acres under sugar cane, the figure had increased to 162,619 in 1920 and to 220,000 in 1923. During the period of high prices great improvements have been introduced by the farmers in their cultivation ; up-to-date implements of improved pattern are now in use and more fertilizers have been given the land during the past three years than ever before. While in 1901 (when 120,058 tons of sugar were made) there were over 60 factories employed, and five new ones have since been laid down, there are now only 37, almost all of the smaller ones having been wiped out , and these factories are of large capacity fitted with greatly improved machinery Simultaneously, the canes have been improved 9 76 tons of cane were required to produce 1 ton of sugar in 1901 whereas in 1923 the figure was 7 60 Incidentally, we gather that the disastrous white grub was much less in evidence during the year

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[1] T. D. CHATAWAY, *I.S.J.*, 1924, pp. 7 and 539.

[2] Annual Report of the Bureau of Sugar Experiment Station, for the year ending 31st October, 1924. H. T. EASTERBY.

Considering the dominance and irregularity of the weather, it will be of interest briefly to analyse the rainfall, and in the south the temperature conditions in this record year It will be seen that in the north the amount of rain which fell in one month exceeded the total rainfall in the centre and south during the year

Northern experiment station at South Johnstone —The season was a late one, in that during the early months (September to November) there was very little rain (2 5 in), and this held the newly planted canes back, although the ratoons do not appear to have been similarly checked In December, however, there was a considerable improvement, and 14 09 in were recorded on the station This was followed by 10 in in January and 12 in February, which although below the average at this, the hottest time of the year, caused the canes to make good progress In March, however, 44 19 ins of rain fell, followed by 21 22 in in April and 13 42 in May , and these rains brought on the canes at a rapid rate In spite of this in June when milling usually commences the plant cane crops were still decidedly short in tonnage, and factory supplies were mainly drawn from standovers and early ratoons During June, July and August the falls were 5 66, 7 92 and 4 66, making a total of 135 74 ins for the year These figures are of interest when compared with those of the Central and Southern districts, as reflected in their experiment stations The average tonnage of canes grown on the station was 35 06 per acre, or slightly larger than in the previous year

The Central Experiment Station at Mackay —The season commenced with extremely dry conditions less than one third of an inch falling for the first three months (September to November), while December and January together only added about 5 in But in February over 21 in were recorded, this being followed by about 15 more during the next three months of the growing period The total for the growing season (September to August) was 43 60 in which, while about 11 in more than in the previous year, fell short of the average for the station by as much as 20 in The amount appears, however, to have been sufficient for the healthy growth of the canes, with an abnormally high average of commercial cane sugar The average weight of canes grown on the station during the year was 21 5 tons per acre, as compared with 13 1 in the year before

The Southern Experiment Station at Bundaberg —The growing season was again unsatisfactory for the growth of a good crop of canes The tonnage is not given, but is reported to have been "somewhat heavier than in the previous year," when it was only 8 28 tons per acre on the station The details given show sufficiently well the kind of difficulties experienced in this part of the sugar belt. The winter was more severe than in the three previous years, the frost extending well into August, although not severe enough to injure the young canes. The rainfall during the winter was good and, after August, growth commenced rapidly But after the middle of September there was a setback, the rains being extremely meagre and merely sufficing to keep the canes alive. Good soaking rain (4 29 in) fell in December, and again the canes responded; but a further setback was experienced in January when there was only 1 in. Favourable conditions prevailed from February to April (with rainfalls of 9 5, 9 5, and 1 5 in.) but little more rain fell during May and June, when the cold weather put an end to further growth.

Judging from these figures, carefully recorded on the Experiment Stations, the climate of the year cannot well be credited as having had much influence in producing such a great increase in production. And, moreover, it is not difficult to understand why the sugar tract, as a whole, is reported to be slowly but surely moving towards the north. But when we glance at the inspection notes made by the Director and his staff when touring through the districts, the complexion of affairs is materially altered. Selecting, for instance, the *Bundaberg district*, we read of a prosperous season everywhere: "A fine season is being experienced in this district . . . . new areas have been planted out . . . . In the Bingera area there is every prospect of good yield . . . . At Gin Gin the cane crops are in good condition and should harvest an average of 20 tons . . . . the cane growers are gradually extending their areas. Land is being ploughed up and planted that has been idle for years, excepting for grazing purposes . . . . . A big crop should be harvested at Avondale this season. The plantation and farms have been excellently cultivated and the growers are reaping the benefit accordingly . . . . Sharon, Millbank and other sub-districts are also cutting good crops this year." And so on, throughout the southern districts, near whose sugar tracts the Bundaberg station appears to be the only one as yet started.

As to the *Mackay district*, we read: "The Mackay cane areas are experiencing probably the best season yet recorded. Not only are the yields of cane excellent, but the commercial cane sugar in the cane is remarkably high, due to four months of dry weather following good rains . . . . figures as low as 6½ tons of cane per ton of sugar have been realized . . . . much new land is coming under the plough." Speaking of Koumala, recently opened up in this district, we read: "Koumala is admirably suited for closer settlement, as the land is accessible to cultivation and is well watered . . . . There are a number of settlers in this locality from Great Britain. They are getting on well and are satisfied with the new life." In the *South Johnstone district*: "A splendid season is in progress in this area, although owing to much heavier rainfall the quality of the cane this year is not so high as it was in 1923 . . . . The district is in a highly prosperous state. Each of the three mills is crushing up to full capacity, and there are exceedingly fine crops of canes in evidence. The South Johnstone mill was dealing with a vast amount of cane, which it was crushing at the rate of 6500 tons a week; and about 165 tons a day were being railed to Giru mill to relieve South Johnstone."

It is obvious from these extracts that the season was responsible to a considerable extent for the heavy crop, and that it is not safe to judge of the climatic condition of the sugar belt from the records kept at the stations alone. And, while there is no doubt that the experiment stations are of the greatest value as distributional centres, we are led to wonder whether the complicated series of experiments, as for instance those at Bundaberg, are likely to be of much use to the farmers. It appears at any rate likely that, when the latter visit the station, they may not be so impressed as they might be, if the plots they see are inferior to their own; and they may be excused for not making due allowance for any local circumstances which should be taken into account. Mackay is stated to be of great use to the local farmers, but the location of South Johnstone is condemned in every issue of the report, where we read the recurring paragraph: "The piece of land used as a site for the Northern Sugar Experiment Station was selected owing to its being Crown land. It is situated at the foot of the Basilisk range, upon the opposite side of the river to the South Johnstone mill. The land is of poor quality, low in available phosphoric acid and lime, and, like most of the soils in the neighbourhood, contains a larger percentage of magnesia than lime."

In these circumstances it may not be interesting to the readers of this journal to follow in detail, as has been usually done, the minutiæ of the experiments being conducted on the three stations; and a reference to previous notices will probably suffice for the present.[1] So that, although much of local interest is contained in this voluminous report, it may be more profitable to concentrate on one point naturally leading out of what has been said already in this review, namely, the praiseworthy efforts made year after year at introducing a frost-resistant cane into the southern tract.

For a time, a cane introduced from north India under the name Shahjahanpur No. 10 showed very considerable promise, and it was noted with regret that this cane was ploughed out last year, as it showed signs of being attacked by mosaic disease. But lately it has been found that this variety turns out not to be an Indian cane at all, although it was naturally accepted as such in Queensland. Dr. CROSS, who had read about its bright green colour under frost conditions, obtained it and grew it at Tucuman; but on thorough examination it was found to be no other than the well-known POJ 36.[2] Why it should have been distributed overseas from India under a number which led one to suppose that it was a north Indian cane is somewhat difficult to understand; but, in any case, any complication in the intricate matter of the nomenclature of sugar cane varieties should, if possible, be avoided. And a further argument in favour of labelling a cane variety with its own well-known name may be drawn from this very case. These POJ seedlings with Indian blood in them have been now exhaustively studied as to their relations to the mosaic disease; and it has been again and again demonstrated that, while suffering little themselves from the affliction, they very readily contract the disease, and may thus act as unsuspected carriers until the whole country of their adoption may be permeated by this insidious malady.

This year it is stated that Shahjahanpur Black has been introduced at Bundaberg. There are not many indigenous Indian canes deserving this name, and it is excusable to surmise that possibly here too is a cane variety known elsewhere under a different name. The Director also states that three Coimbatore seedlings have been introduced. While everyone would wish that these four, presumably frost-resistant canes, may prove successful, it is of special importance that they should be tested as to their liability to mosaic. This applies to the Indian seedlings as well as to Shahjahanpur Black, as it is stated that this disease is not an Indian one It may also be observed that, of the seedlings issued from the Coimbatore station, those with numbers 200 and onwards have been bred to withstand the severe conditions of north India; and, as such, they are unlikely to find favour anywhere where it is possible to grow good thick cane.

In conclusion, it will not be so very surprising if the Java seedlings with Indian blood in them, and the somewhat similar crosses raised at Coimbatore, may ultimately prove of real benefit to the southern portion of the Australian sugar belt. But, if so, it tends to show that this extra-tropical tract is not really suited to the growth of this tropical plant. Natal found this out early, and owes its present prosperity to an Indian cane, pure and simple. Argentina followed with seedling varieties containing Indian blood; and Egypt has lately completely changed its varieties in the same sense, and Spain is reported to be doing so too, at any rate to a considerable extent. Lastly, the latest advices indicate that Louisiana is about to follow suit. These facts are all to the good, for every one of these places is well outside of the tropics, and the change to canes of more hardy character is only the natural outcome of the long fight of the sugar industries in these places against almost impossible climatic conditions. In other countries, where tropical conditions prevail, these hardy varieties may also be of use, either for fodder purposes, or for growing on lands which have proved less suited to better class canes, either because of inherent sterility or from the presence of overmastering diseases.

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[1] See *I.S.J.*, 1924, 438; 1923, 289, 1922, 198.

[2] *Facts about Sugar*, 1924, p. 185.

C. A. B.

Cane Cultivation in Luzon.

Some interesting facts concerning sugar cane cultivation in this, one of the two great islands of the Philippine group, can be gathered from the "Compilation of Committee Reports for the Second Annual Convention of the Philippine Sugar Association," held at the beginning of October last year. These islands during the past have, after various ups and downs since the United States' occupation in 1898, at length reached the level of Formosa and Porto Rico in sugar output, the figures given for the 1924-5 crop being 462,000, 460,000, and 464,000 tons respectively.[1] Four fifths of the sugar cane area is situated in two islands of the archipelago, Luzon and Negros, although it is apparently quite possible for this crop to be grown on many of the multitude of fertile but undeveloped islands composing this large country, whose area extends to 127,853 square miles. And the comparatively small island Negros, under 5000 square miles in extent, and its great sister Luzon, with over 40,000, have practically the same acreage under cane, each of them cultivating round about a quarter of a million acres.[2]

Both of the islands are largely cut up by mountain ranges, and this apparently has a considerable influence upon the climate of the eastern and western coasts. In such conditions there are well marked wet and dry periods. On the western sides the rains occur, as in India, from June to October, while a long dry period extends from November to May ; and these times are reversed on the portions to the east of the mountain ranges. In both Luzon and Negros there appear to be high mountains in the interior, and the cane cultivation is more or less concentrated on the western side ; this being the case, of the 70 inches of rain falling on the average during the year, 50 fall between July and October. Where the mountain ranges are broken, however, and great plains are met with unprotected from the trade winds, the rainfall is fairly equably distributed throughout the year.[3]

After the United States acquired the islands from Spain in 1898 and the resulting chaos had somewhat subsided, marked attention was naturally paid to the possibilities of improving the sugar industry, as the Philippines had proved for many years particularly suited to this crop.

A gradually increasing amount of capital has poured into the islands, resulting during the last few years in the establishment of great Sugar Companies, with large factories equipped with modern machinery, and controlling extensive areas of land suitable for cane cultivation ; but, as in almost all such cases, the actual cultivation remained in much more backward condition than the sugar manufacture, and in the present article some of the endeavours to set matters right in this respect will be dealt with. Concerning the closely cultivated Negros a good deal has been written, but in the more isolated centres in Luzon there is less to lay hold of, and it will be more interesting to see what is being done there by the newly formed associations of planters and factors, which are just now so much to the fore in the Philippines.

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[1] *I.S.J.*, 1924, 673 (Est.).

[2] Figures for 1920 in *Philippine Agricultural Review*, xiv, 2, 1921.

[3] "The World's Cane Sugar Industry," H. C. PRINSEN GEERLIGS.

Although the main thesis of the papers on cultivation presented to the Convention is the best means for the recovery of the fertility formerly characteristic of the islands, one writer, ANGOLO Y VARELA, offered a short description of the opening up of new lands for cane, under the system known as "caingin" or "Gosak." The trees and bushes are cut down and left on the ground for two or three days, during which time the more valuable portions are removed to safety. Then the remaining shrubs and branches are gathered round the stumps and, when dried, are fired. After this is done the land is cleared of all movable parts, and planting commences without the removal of the stumps. The cane "points" (sets) are soaked in fresh water for 24 to 48 hours, according to age and quality, and then brought to a rough shed where they are spread out, selected and covered over with dried leaves or straw, for germination (shooting of the buds) to take place. The points are then ready for planting either by staking or holing. In the former the planter armed with a sharp stick makes holes in the ground and presses the sprouted set in, firmly treading the soil around, just as has been described for Cuba. The plants are placed 18 in. from one another in rows 3½ ft. apart. In holing more care is taken, and separate holes are dug 4 to 5 ft. from one another in all directions, each hole being 15 in. long, 10 in. wide and 14 in. deep, part of the loose soil being dragged in again to about a depth of 6 ins. Two or three points are planted in each hole with about 5 in. projecting above the surface. In both cases cultivation is done by hoe, and five acres are regarded as a reasonable area for one man to take charge of.

The cost of the operations during the first year—clearing, holing, planting, cultivation, enclosing and administration—is given as 240 to 290 pesos per hectare (say about £10 per acre); and it is claimed that this investment of capital can easily be met by the proceeds of a first crop of cane. Similarly, the first and second ratoons following will pay for the completion of the clearing operations, namely, the removal of the stumps of the trees left after burning. The method as described appears to be a reasonable one and involves little locking-up of capital.

The Chairman of the Committee of Cane Cultivation in Luzon, H. T. HUNGERFORD, considered land already long under cultivation, and read a paper on "Some Elementary Principles of Cane Cultivation." The preparation of the soil is first discussed, the author declaring that lack of care in this respect may be largely responsible for the poor germination of all classes of seed cane. Deep ploughing he regards as essential, but he makes it very clear that this must be got over before the onset of the rains in June-July. And he recommends that nothing more should be done before the rains are over, in that these will fine down the soil, if left as rough as possible, far better than any human means. Unfortunately weeds will, if unchecked, grow apace during the rainy period, and a second deep ploughing may be necessary after the rains have ceased. But to avoid this he proposes that the rough ground should be sown with beans with broad leaves (velvet, Mauritius, or even the local *patani*) to protect the soil from injury, and keep the weeds from growing overmuch. Such a crop could be put under by double mould board plough with a sharp disc coulter added for cutting them up, and they could be covered over by the soil from the next furrow. The tilth would thus be preserved, the soil enriched, weeds would be kept down, and the cost of preparing the seed bed greatly reduced.

After the rains, no deep ploughing should be permitted, for fear of the loss of moisture during the long dry period following. In any case the soil should, if possible, not be stirred below the depth of the furrow in which the cane sets are placed. For the suppression of the weeds which appear, cultivators would be preferable to ploughs, at the same time producing the much to be desired mulch for retaining the moisture in the soil. But the whole question is approached from another point of view, namely, that of the time of planting. As it is, seed is scarce at the beginning of the planting season (that is, presumably from October to December), because it is dependent on the harvest, and is often thrown late into the dry period. Early planting is of dominant importance. The cane has time to establish itself before the time of stress arrives; it can be cut earlier, and this reacts upon the ratoons in a similar manner; it shortens the cultivation period during the dry weather by rapid closing in of leaves, and thus appreciably diminishes the amount of weeding to be done; "everyone knows the mass of weeds which spring up in late planted fields during the rains." To attain this end then he suggests a modified system of nurseries, chiefly to tide over the early rush in seed demand at harvest time, and to make planting less dependent on cutting. Such seed beds need not take up much room, as the sets can be planted thickly in rows half the usual distance apart; by ploughing out alternate rows when the seed is required, the rest of the field, when thinned, can be profitably grown on as plant canes. But another factor must be considered. It has been found that points with an appreciable amount of sucrose in them do not germinate well, so that the time of planting the nursery should be arranged for the young canes when cut for planting are still in the plastic, glucose state. Any seed bed put down before June 1st is found to suffer from this fault; but by sowing in June or July the points will be in proper condition for planting in October, November or December, before the dry condition of the soil has well begun. This factor appears to be well appreciated by the native cane cultivators, for it is the usual custom to "cure" the cane before planting, by allowing it to lie for four or five days, thus allowing some of sucrose to change into the more plastic glucose form. It is recommended that this curing should take place before soaking the sets, as otherwise moulds readily appear and take their toll of the sprouting seed cane. There is a strong local preference for plant as against ratoon canes for seed; the reason for this is again the incidence of the dry season, for it is usual for the plant canes to be thicker and more juicy, and thus less liable to dry out in the early stages of growth. All of which tends to show that the long period of dry weather each year is an unusually important factor in the growth of the canes in Luzon.

A careful distinction is drawn between earthing and hilling up. By the former the author indicates the gradual drawing of the earth to the canes, which in early planted fields may be continued right up to the onset of the rains, the cultivation being more or less flat till then. If, however, the planting is late, hilling up becomes necessary to protect the young roots from the intensely hot sun of the dry season and also to conserve moisture around them by the mulch thus formed. Hilling up is, however, found to interfere with the proper tillering of the stools, while also presenting a larger surface for evaporation. With ratoons the same general principles are adhered to. When the canes are cut early, the rows should be offbarred at once, but left open till tillering commences; then they must be hilled up, because ratoons are set higher in the ground than plant canes and need protection from the heat. Late cut canes should be offbarred similarly, but the hilling up must be done immediately afterwards, no advantage being gained by allowing the stool to remain exposed, while much moisture is inevitably lost.

These are a few of the interesting points brought out by the author of this paper.

Crop rotation and green manuring were treated of in a short paper by ANDRES P. GONSECO. He points out that most of the soils in Pampanga (the chief cane producing tract in Luzon) are depleted to such an extent by continued cane growing that there is, even with the utmost care, little margin left for profit. And this he puts down to a faulty system of rotation, namely cane, corn, rice and cane. Rice is vital for food production, but the corn (maize) has apparently only been introduced to avoid the dangers of a fallow in such a dry, hot country. All of these crops are such as need nitrogen and the main cause of depletion is the loss of humus. Recognizing this fault, the Pampanga Sugar Development Company, with the co-operation of some of the more progressive planters, introduced cowpeas and mongos (grams, *Phaseolus mungo ?*) in place of the corn. This was met with the most stubborn resistance from the "inquilinos" (tenants) but was carried through. The results proved so eminently satisfactory that none of those who have once tried this change have consented again to plant corn, it having been found that not only was the effect on the ground extremely beneficial, but there was actually considerably more profit financially from the peas than from the corn. The new rotation is therefore cane, cowpeas or mongos, rice, cane. This is a most important advance. The legumes are sometimes grown for their pods and sometimes turned in when flowering. If the pods are wanted, planting must be done between November and January; planting from February to April is unsuccessful, for the soil is already too dry for the full development of the plants; while planting in May or June induces a great growth of foliage but a poor crop of pods. For such a crop it is necessary to plant in rows because of the need for interculture "on dry days." When pods are not wanted, the seed is sown broadcast before the rains and covered in by harrowing.

The main factor is the proper rotting of the dug in vines. This the author carefully investigated. He found that during the rains (in July and August) the normal time required for rotting was on the average 16·5 days, after which the vegetable matter could be thoroughly incorporated with the soil. Further experiments showed that in six plots thus treated and six others where no peas were grown, both in clay soil, the weight of the mass in the incorporated condition was 10 per cent. less than in the unaltered clay. This made the soil much easier to work and increased its water holding capacity. On drying equal quantities of the clay and the mixed soil, he also found that, after five hours, the loss in weight was 20 per cent. and 22·3 per cent. respectively, a difference which was put down to the larger amount of water absorbed by the humus.

It will be seen from these extracts that the cultivation in Luzon is still very much behind hand in modern methods, but that the members of the Convention are fully alive to this and are making strenuous efforts at improvement under specially trying climatic conditions.

C. A. B.

From May 23rd to June 7th next a sugar exhibition is intended to be held at Magdeburg, Germany, at which the industry itself, the industries using sugar in any form, big engineering works interested in the sugar industry, and the allied technical industries, will all be represented.

The Instructional Sugar Factory of the Trinidad Imperial College of Tropical Agriculture.[1]

The Model and Experimental Sugar factory of the Imperial College of Tropical Agriculture, Trinidad, has entered upon its first crushing season, and the result of the operations during 1925 will be awaited with considerable interest. The original idea must be attributed to the energy and foresight of Sir Francis Watts, K.C.M.G., D.Sc., now Principal Emeritus, whose interest in, and work on behalf of, the prosperity of the British sugar industry is universally recognized. But the scheme for the erection of this model factory was enthusiastically adopted by the Governing Body of the College and the services of an eminent expert, Mr. Claud Berthon, A.M.I.C.E., were secured to assist in its promotion. A meeting was convened in Glasgow as far back as 1921 at which he and Sir Francis Watts explained the object of the proposed factory to an enthusiastic body of sugar machinery manufacturers and others. It is a remarkable tribute to the generosity and far-sightedness of these British sugar machinery manufacturers that the meeting resulted in the promise of practically the whole of the equipment to the value of £20,000 for the proposed factory. The result is that the model factory is actually equipped with a full complement of the latest types of sugar machinery supplied by the world's finest manufacturers, and is capable of turning out a very wide range of commercial sugars by the most modern processes.

Unfortunately a hiatus occurred. Faced with the difficulty of securing sufficient funds to complete the new buildings of the College and in the absence of what Mr. Fisher described as "a corps of well-trained millionaires," which appears to be at the command of every American University, the idea of the sugar factory had temporarily to be shelved. The planting community of the small Colony of Trinidad and Tobago, with unparalleled generosity, and in spite of the fact that the colony is but slowly emerging from the trough of a profound trade depression, magnanimously urged upon its Government that a produce tax should be imposed upon agricultural exports with a view to raising approximately £50,000 in order that a beginning might be made to the permanent buildings designed by Major Corlette, O.B.E., F.S.A., F.R.I.B.A.

With funds for the College building assured by Trinidad and other Colonial Governments the idea of the sugar factory was resuscitated with renewed vigour, and events have since moved rapidly. Special recognition is due to Mr. Claude Berthon who is responsible for the design of the factory and the co-ordination of the constituent elements of machinery. The whole of this arduous work has been performed by him in an honorary capacity as Consulting Engineer and all connected with the College are extremely grateful to him for the important services which he has rendered.

The factory was erected under the direction of Mr. G. Mayes, who assisted Mr. Berthon in the design. Mr. Mayes now occupies an important position in the Basseterre Sugar Factory, St. Kitts. The factory will be operated under the direction of Mr. O. F. Boyd, Professor of Sugar Technology, son of Colonel Thomas D. Boyd, President of the Louisiana State University, to which is attached the Audubon Sugar School in which Professor Boyd was trained.

The model Experimental Sugar Factory of the Imperial College of Tropical Agriculture is the first of its kind to be erected in the British Empire, although pride of place must be yielded to America, where the Audubon Sugar School of the Louisiana State University was the first instructional and experimental sugar factory in the world. Astonishing claims are advanced on behalf of this School and it is earnestly hoped that when the Sugar Factory of the Imperial College of Tropical Agriculture can boast of the same ripe experience it will be able to advance equally ambitious claims.

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[1] A much abridged account based on articles by C. Y. Shephard, B.Sc., and Prof. O. F. Boyd, B.A., in a supplement to *Tropical Agriculture.*

There has recently been a strong revival of interest in the production of sugar in the British Empire which follows on a long period of inconsistency on the part of successive Ministries at home that has had a most demoralizing effect on the industry as a whole. It is now hoped that recent and pending legislation destined to encourage both beet and cane sugar within the Empire marks the end of this weathervane legislation. As it is, it is eminently fitting that the completion of this sugar factory at Trinidad should coincide with this revival of interest, since the College possesses adequate facilities for the training of sugar technologists in every branch of factory control. But one thing is lacking which is an estate of a size commensurate with the needs of the sugar factory for sugar cane, and, in addition, the other tropical crops for training in the cultivation of which the College offers unique facilities. The College at present lacks even an adequate area for the cultivation of sugar cane upon an experimental scale; but it is essential if it is to fulfil its Imperial aim that it should be in a position to offer equal facilities for technical training in the cultivation side of the industry. The relation between estate and factory should be of a highly intimate nature. The College is fortunate in being situated in an area abounding with large scale estates whose proprietors and managers have generously offered facilities for study to the staff and students of the College, but admirable though they are, they form no substitute for the knowledge and confidence which can be obtained only from a practical handling of men and an intimate contact with the problems which confront every sugar estate manager in the tropics. The acquisition of this estate, which would be of an essentially reproductive nature, is a part of the accepted policy of the College, but the idea languishes through the lack of adequate ways and means. It may be that the generosity of those interested in Empire development will afford the College the facilities to justify itself. *Via colendi haud facilis.*

The experimental factory started manufacturing operations during March of this year. The local department of Agriculture very kindly consented to furnish about 2000 tons of canes for the factory. These canes are of numerous varieties and will give an opportunity for observing the milling and factory conditions as they vary with the different types. Although not entirely a gift, the supply of canes will be partly so. It is the intention this year to try and make the factory pay financially, that is to clear enough from the sale of the sugar and molasses to pay the actual operating expenses, and with this end in view, very little change will be made in the type of sugar manufactured. Yellow crystals will in all probability be the principal grade of sugar to be produced—because of the good market in Trinidad for that particular type.

As above mentioned, the equipment and machinery in the factory is largely a gift of the various manufacturers of sugar factory machinery throughout Great Britain, and it is mainly through their generosity and kindness that the erection of the factory was made possible. Most of the other large mills, evaporator, etc., units are entirely the gifts of their producers, but in some cases the unit is only partly a gift inasmuch as a substantial reduction in price has been allowed.

As the cane enters the factory yard it is weighed on a weighbridge which is a gift of Henry Pooley & Son, Ltd. The scale beam and operating section are enclosed in a small house so as to protect the operator from the weather. The cane will be transferred to the cane carrier by hand, and thence to the mills where it is crushed and the juice extracted.

The entire milling plant consists of the cane carrier, an 11-roll mill, and bagasse elevator, all of which are driven by one steam engine. The entire plant was furnished by the Mirrlees Watson Co., Ltd., as a gift to the College. The mills are of sufficient capacity to crush two or three tons of cane an hour and are 16 ins. × 21 ins. The driving engine is fitted with a link-reversing gear so that the rolls can be reversed if the occasion should arise. A very unique bagasse weighing machine has also been installed, so that an accurate check can be kept on milling operations, as well as fuel and boiler problems. The weighing device is the gift of S. Denison & Co., Ltd. and is perhaps the only one of its kind in existence.

After the mixed or dilute juice has left the mills it is pumped to a nest of tanks almost at the top of the building. From these tanks it is drawn into large pivoted tins set upon a scale, where it is weighed. These weighing machines are so hinged that they can be tipped over and the juice discharged into a similar nest of tanks just underneath the top nest. These weighing machines are the the gift of W. & T. Avery, Ltd.

After the raw juice has been weighed and discharged into the lower tanks, the process of clarification is ready to be started. Almost any type of clarifying can be carried out, and changes made in the process at any time. This is rendered possible by the extreme flexibility of the arrangement of the pipe lines, and the large capacity of the other units in proportion to that of the mills. The piping is so installed that the flow of the juice can be sent in almost any direction, to conform with the necessities of the particular methods of manufacture in use. As it is obviously impossible to describe in this space more than one process, an effort will be made to outline the manufacture of plantation white sugar, and to follow the flow of the various juices, syrups, and molasses throughout this process, mentioning and describing the different units used in the above-named method.

The juice upon leaving the lower nest of receiving tanks can be saturated with sulphur dioxide either in a sulphur tower, or in a sulphitator, and thence pumped to the liming tanks, where milk-of-lime is added until the required acidity is reached. The treated juice is next pumped through the juice heaters, one of which is a high velocity heater, and the other a low one. These are the gifts of A. F. Craig & Co., Ltd., and can be used either as separate units or in series. The heated liquor is allowed to subside or defecate in open subsiders, the clear juice is drawn off and sent to the evaporator charge tank, and the scums are retreated and allowed to settle again in the second subsiders, the clear juice is again drawn off and sent to the evaporator charge tank, and the scums to the filter-press charge tank.

The scums are treated in the usual way, limed and boiled, and filtered through plate-and-frame presses. These presses have been presented to the College by S. H. Johnson & Co., Ltd., together with a 3-throw pump, and the charging and receiving tanks. Two of the presses are to be used for filtering juice scums, while the third may be used either for juice scums or syrups. The same firm have also furnished, as a gift, a small gravity filter of the Philippe type for the filtration of the syrup together with the necessary charging and receiving tank.

The filtered juice can either be mixed indirectly into the clarified juice going to the evaporators or if too highly alkaline it can be returned to the liming tanks and sent through the process again.

The main body of the clarified juice is now ready for the evaporation process. The evaporator is a triple effect presented by the Harvey Engineering Co., Ltd., and has 700 sq. ft. heating surface. It is mounted upon staging also furnished by the above firm.

The vacuum engine or pump has been presented by George Fletcher & Co., Ltd., along with two surface condensers, one of which is connected to the pan, the other to the triple effect. The pump serves the purpose of producing vacuum for both pan and triple and is connected to both condensers. The valves are so arranged that either unit can be cut out of service when necessary. The circulation water pump is of the centrifugal type, motor-driven, and was a gift of Drysdale & Co., Ltd

The concentrated thick-juice or syrup, after leaving the evaporators may be treated in numerous different ways due to the flexibility of the arrangement of the piping and the apparatus. In this process, however, for plantation whites, it will be re-sulphured and filtered through the gravity filter described above and sent to the pan-charging tanks, and concentrated to sugar. It is unnecessary to describe the various methods of boiling and of pan work in use in manufacture of plantation whites, but it will suffice to say that the method best adapted to the local conditions will be sought for and adopted.

A 3-coil vacuum pan was furnished as a gift by A. & W. Smith & Co., Ltd., and has a capacity of 50 cub. ft. It is of the most modern type and equipped with the necessary accessories, including a cup for seeding or shock graining. Beneath the pan are three water and steam jacketed crystallizers of the open type, of about 55 cub. ft. capacity, and below these is the mixer. These units have been given by Watson, Laidlaw & Co., Ltd.; and Pott, Cassels & Williamson have donated the two centrifugals just beneath the mixer. The massecuite can be discharged directly into the mixer or into the crystallizer, and the mixer is divided into two compartments to facilitate the separation of first and second sugars. There has been no provision made for a granulator, but it is to be hoped that in the future one might be secured, so that plantation granulated sugar could be manufactured.

The sugar store is just adjoining the centrifugals and the necessary scales and bagging equipment have been provided. The water supply comes from two artesian wells, both connected to a deep well pump given by Worthington-Simpson, Ltd.

The boiler has been donated by Babcock & Wilcox, Ltd. and is of the water tubular type. It has approximately 1800 sq. ft. of heating surface, and is equipped with all the necessary appliances, including a safety high and low water alarm. The boiler mountings are the gift of J. Hopkinson & Co., Ltd. and include fire bricks.

The boiler feed pump is of the Weir type and was donated by G. & J. Weir, Ltd. Between the boiler and the chimney is a Green's Fuel Economizer which has been presented by its manufacturers, Messrs. E. Green & Son, Ltd. It is for the purpose of heating the boiler feed water by means of the flue gases. Motor-driven scrapers keep the tubes clean and prevent incrustations of soot and ashes. The economizer can be removed from service by means of two dampers which deflect the gases through a by-pass directly up the chimney. Either oil or bagasse may be used as fuel in the boiler, and the oil equipment has also been presented by Babcock & Wilcox, Ltd. It consists of a pump and pre-heater and a patented nozzle for oil burning of their own design.

Practically all of the pumps are motor-driven and the electrical equipment consists of 11 motors and control gears, a main dynamo, and a smaller dynamo driven by a Petter engine.

Joseph Evans & Sons have given several 3-throw pumps for the juice: and other donations, include an air compressor—given by the Usine Sainte Madeleine Co., Ltd., a local sugar factory—two eliminators by Fawcett, Preston & Co., Ltd., a sugar melting pan by Duncan Stewart & Co., Ltd., and three reducing valves by Sir W. H. Bailey & Co. Ltd.

Problems involved in the Chemistry of the Sugars.

A most interesting Friday evening discourse at the Royal Institution was given recently by Sir J. C. IRVINE, Ph.D., F.R.S., Principal of St. Andrew's University, Scotland, who took for his subject, "Sugars from the Standpoint of the Organic Chemist." He described important work hitherto unpublished.

QUESTION OF A SIMPLER MOLECULE THAN GLUCOSE.

He would not attempt, he said, to trace the steps which had led to our present ideas of what sugar really is, viewed as a molecule. From the time the chemist had given it a molecular structure, however, sugar investigations ceased to be empirical, and had become an organized part of organic chemistry. The whole range of carbohydrates and sugars had now been classified into monosaccharides (glucose), disaccharides (sucrose), and polysaccharides (cellulose and starch). Glucose ($C_6H_{12}O_6$) is really the compound from which the other sugars and polysaccharides arise. In his opinion, there is a simpler molecule than glucose, something which is the source and origin of glucose itself, but at this stage he would not commit himself to an opinion as to what that simple molecule might be. It might be formaldehyde, or it might not, but there is a simpler molecule which gives us glucose.

WHAT GLUCOSE METHYLATION HAS TAUGHT.

One must remember that the essential properties of glucose exist in one particular part of the molecule, in fact, in the hydroxyl groups, the rest of the molecule doing very little. Is there any difference between these hydroxyl groups? It is a very nice question to ask, but a very difficult one to answer, because if one took glucose and acted upon it with any chemical reagent which was capable of reacting upon hydroxyl groups, the reaction went straight down the chain. It was, however, possible to take away the hydrogen atoms from the hydroxyl groups and replace them by the methyl group. There had been a great deal of what might almost be called juggling with the sugar molecule to introduce methyl groups, and when finally the methyl group had been put into every hydroxyl position, all the sugar properties vanished. With three methyl groups, there was a change from the solid crystalline condition to a liquid condition; whilst the final product, in which all the hydroxyl groups had been replaced by methyl groups was a mobile liquid, easily distillable, possessing no sugar properties whatsoever, and was a clear indication that in this compound we had passed away from the sugars altogether. (A specimen of glucose with two methyl groups was shown, which had taken two chemists two years to obtain.)

What results had followed from the study of these compounds, and what do we now know regarding these different hydroxyl groups? This much clearly emerged, viz., that the properties of glucose were largely confined to three positions in the molecule, and the part that mattered most was the —C H O group at the top of the chain. That was the reducing group of the glucose, and was the first part of the molecule to be attacked. The remaining important positions were the five and six positions in the molecule, both of which had their specific reactions.

CONSTITUTION OF CELLUOSE.

These are only a few of the properties of methylated sugars, and the principal applied them to two cases only, which were still unpublished, and had led to discoveries to a certain extent fundamental. Cellulose, about which a great deal was known, is still a baffling kind of substance. We know with certainty about cellulose; that it is built up of glucose molecules joined together. The earlier idea was that these molecules were joined end to end, but there is now an alternative idea. At the present time the bulk of the evidence was entirely opposed to the idea that cellulose is built up of large units, and points to it consisting of small units joined together, and these small units seem to consist of three glucose molecules joined together, and not two.

HAS SYNTHETIC STARCH BEEN MADE?

There is, however, still a great deal to be learnt. How are the molecules joined together, and what are the forces which hold them? That was where the organic chemist stopped short and looked to his physical brethren for enlightenment. The chemist has artificially prepared glucose and some of the disaccharides, but he has never prepared artificially a polysaccharide, and it seems a heroic task to set out on such a venture. Yet, in a blind and almost blundering way, the chemist has stumbled on something which, if not exactly the synthesis of starch, is very near to it. This, again, represented unpublished work, and he referred his audience back to the discovery of PICTET, for which he had great admiration, because it showed the merit sometimes of drawing a bow at a venture. PICTET distilled starch in a high vacuum, and he did not know what it was he expected to get, but he converted ordinary starch into a most beautiful crystalline substance, a material known as glucosan. Then PICTET, with an ingenuity which did him credit, tried to reverse the process; he started with glucose and tried to convert it into starch. He did not succeed, but he got a material which he called a synthetic dextrin.

It was decided that a parallel study should be conducted in the Principal's laboratory. Glucosan fused with the addition of traces of metallic chlorides, became opaque, and passed over into a white amorphous solid, remarkably like starch. From that mixture, after a long and complex process, he had isolated a pure white substance which analysed like starch. It was methylated and distilled in a vacuum and analysed, and the molecular weight determined in the usual way. When that was done, the molecule was broken into pieces, and the methylated sugars which were then formed were isolated and identified with this extraordinary result; a substance which he called glucosan maltoside. He would called it a synthetic starch. It had one glucose molecule joined to glucosan, but the point was that glucosan had not the structure of maltose, but part of the molecule was maltose, which rearranged itself exactly like starch. It showed that two-thirds of PICTET's synthetic dextrin was chemically and physically indistinguishable from starch, and he regarded it as a most profound and striking discovery for the sugar universe. There was much to be criticized in it, but it seemed to be the first successful effort to penetrate the molecular structure of the polysaccharides.

Looking at the matter as a whole, the Principal said it was inevitable that the reflective chemist should ask where we stand and what are the sugar problems to-day. His own opinion was that for the time being researches on structure had outpaced the efforts to study the reactions of the sugars themselves. Many problems which lie at the very foundation of sugar chemistry remain unsolved. To what cause does the glucose molecule owe its optical activity, and why is the glucose configuration favoured to the exclusion of others; what is the chemical process in nature by which glucose is formed, so desperately difficult to reproduce in the laboratory; and in what manner do sugars lose water? Only when the chemist regarded it as a crime to conduct sugar synthetic reactions at the boiling point would there be any real hope for sugar chemistry.

Investigation of the Colloids of Cane Juices and Syrups in Natal and Mauritius.[1]

By R. G. W. FARNELL.
Chemist, British Empire Sugar Research Association

GENERAL CONDITIONS IN NATAL.

The climatic conditions of Natal are peculiar. The rainfall for the last six years has been low, culminating this year (1924) in an unprecedented drought, whilst, moreover, frosts frequently occur during the winter and severely damage the cane. The importance of Uba cannot be exaggerated, as it accounts for over 99 per cent. of the total cane grown in Natal, and so far has been the salvation of the sugar industry of that country.

It seems as if the phenomenal hardiness of the Uba cane is partly due to its high colloid content. These colloids bind water and increase the resistance of the cane to drought and disease.[2]

Owing to the slow growth of the Uba cane in Natal (where it takes two years to mature), the sucrose content is generally high, and its purity very fair. Its glucose content, though, is low; while its ash and colloid content is high. Consequently, recoveries are generally low, averaging about 78 per cent. of the sucrose in the juice for those factories working the sulphitation process, and making white sugar.

Uba juice is difficult to clarify owing to the high quantity of colloids, and even for the manufacture of 96° sugar it is necessary to sulphur the juices, as the "muds" do not settle if the juices are merely limed and heated. For the manufacture of white sugar, the raw juice is sulphured cold to about 1·5 grm. SO_2 per litre or higher, the pH being about 4·0,[3] the sulphured juice is limed back to litmus neutrality, or slight acidity, pH 6·9, and after heating, the juice is settled, phosphoric acid usually being added. The only factory where all the clarified juice is filtered works the carbonatation process (De Haan's modification[4]). Recovery with carbonatation is considerably higher than with the sulphitation processes employed by the other Natal factories, and the sugar is of much better quality.

GENERAL CONDITIONS IN MAURITIUS.

In Mauritius the conditions are absolutely different. The climate is better suited to the growth of the cane and the average rainfall is much higher than that of Natal. However both climatic and soil conditions vary considerably in different localities, unlike Natal, where things are more uniform.

There is practically no Uba cane in Mauritius, and the juice is very easy to work. White sugar is made entirely by the sulphitation process. Sulphitation is not so intense as in Natal; the raw juice is generally only sulphured to about one grm. SO_4 per litre (pH 4). No phosphoric acid is added to the juice (or only occasionally), although it is often used on the syrup. Frequently the whole of the clarified juice is filtered through plate-and-frame presses, or through

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[1] Published with the kind permission of the British Empire Sugar Research Association.

This paper contains an account of work done during 1924 in Natal and Mauritius, following directly on the lines inaugurated by the writer at the Imperial College of Tropical Agriculture, Trinidad. See also *I S.J*, 1924, 420; 1925, 89, 94 and 141.

[2] c f. NEWTON, on "The Colloidal Properties of Winter Wheat Plants in Relation to Frost Resistance." *J. Agricultural Science*, 1924, 178.

[3] *I.S J.*, 1925, 141

[4] *I.S J.*, 1923, 378, 624

Philippe filters. In two factories the syrup is filtered between the 3rd and 4th vessels of the quadruple effect through vacuum Philippe filters. In Natal this would be quite impossible owing to the great quantity of wax, it being possible to filter the Uba juice only after carbonatation, and the syrup either by carbonatation or by Bach's process.

The methods of boiling vary considerably in Mauritius, unlike Natal where a straight three-massecuite system is general. There are one, two, and three massecuite-processes in different Mauritian factories and sometimes there is much re-circulation of the molasses. The average boiling-house recoveries are high, about 84–85 per cent., figures only reached in Natal by the carbonatation factory.

EXPERIMENTAL.

Various juices and molasses were taken from different factories in the two countries and the following constituents determined by methods already recorded elsewhere[1] :—

(1) Total colloids (non-dialysable substance).
(2) Total "pentosan" (furfural yielding substance).
(3) Colloidal pentosan.
(4) Total nitrogen (including amino acid, amide and protein).
(5) Colloidal nitrogen (protein).
(6) Wax (ether or chloroform extract).
(7) Total ash (including silica, ammonia precipitate, lime), and
(8) Colloidal ash ,, ,, ,, ,, also SO_3

A. Juices.—So far we have not very much information about the amount of colloids in raw and clarified cane juices. Table I gives a few figures for some juices of Natal and Mauritius, and also for Louisiana (BREWSTER and RAINES,[2]) and Hawaii[3] :—

TABLE I.

JUICE	Colloids Per cent. Brix	Colloids removed, Per cent.
Natal—		
Raw mixed juice *A*	1·79	—
,, ,, *B*	1·89	—
Mauritius—		
Raw mixed juice *A*	1·36	
Sulpho-defecation clarified *A*	0·26	81·0
Raw mixed juice *B*	2·19	
Sulpho-defecation clarified *B*	0·14	94·0
Louisiana—(BREWSTER and RAINES.)		
Raw juice	1·2 (assumed 15° Brix.)	
Sulpho-defecation clarified	0·4 ,, ,,	67·0
Hawaii—(BOND.)		
Raw crusher juice	1·9	
Lime-defecated clarified	0·8	60·0

BOND found on the average that nearly 80 per cent. of the total colloids were removed by adding lime to the juice until it was alkaline to phenolphthalein, heating to cracking point, and filtering through kieselguhr.

Table II shows some pentosan and pectin figures for Trinidad, Natal, and Mauritius juices :—

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[1] *I.S.J.*, 1924, 420, 359, 480. [2] *I.S.J.*, 1923, 88.

[3] BOND. Reports of the second Annual Meeting of the Association of Hawaiian Sugar Technologists, 1923, p. 152.

TABLE II.

Juice.	Pentosan Per cent. Brix.	Pentosan removed, Per cent.	Pectin Per cent. Brix.	Pectin removed, Per cent.
Trinidad—				
Hand-crushed raw	0·04	—	0·010	
(*pH* 6·7) lime-defecated clarified	0·04	0·0	0·009	10·0
Natal—				
Raw mixed juice	0·34	—	0·38	
Carbonatation clarified	0·08	76·0	(not determined)	
Mauritius—				
Raw mixed juice *A*	0·14	—	0·12	
Sulpho-defecation clarified *A*	0·06	57·0	0 03	75·0
Raw mixed juice *B*	0·27	—	0·08	
Sulpho-defecation clarified *B*	0·13	52·0	0·04	50·0

It is interesting to notice the large amount of pentosan removed by carbonatation and also by sulphitation, whereas ordinary defecation with lime alone apparently removes none (HAZEWINKEL and STEUERWALD,[1] FARNELL[2].) Much of the pectin is also removed by sulphitation (and also presumably by carbonatation) by adsorption.

Table III gives the results of some nitrogen (KJELDAHL) determinations made on juices of Natal and Mauritius :—

TABLE III.

Juice	Nitrogen Per cent. Brix.	Nitrogen removed, Per cent.
Natal—		
Raw mixed juice	0 55	
Carbonatation clarified	0·20	64 0
Mauritius—		
Raw mixed juice	0·26	
Sulpho-defecation clarified	0·22	14·0

It certainly appears that carbonatation removes more nitrogenous substance than sulpho-defecation. RAULT[3] is at present working on this subject in Natal. Silica was determined in the undialysable matter from different juices with results as follows :—

TABLE IV.

Juice.	Colloidal Silica Per cent Brix.	Per cent. Colloidal Silica removed.
Natal—		
Raw mixed juice	0·099	—
Mauritius—		
Raw mixed juice *A*	0·017	
Sulpho-defecation clarified *A*	0·003	82
Raw mixed juice *B*	0·033	
Sulpho-defecation clarified *B*	0·006	82

It is interesting to see that over 80 per cent. of the colloidal silica present in two Mauritian juices was removed by sulpho-defecation (sulphuring before liming). MULLER[4] has shown that little colloidal silica is eliminated by liming before sulphuring unless the juice is first heated to over 100°C. His observation has been confirmed in some defecation factories by BIRD[5] in Demerara. Furthermore although direct experiments have not been made on carbonated juice it seems probable that carbonatation removes more colloidal silica than does sulpho-defecation since the amount of colloidal silica in Natal carbonatation molasses is less than one half that of the sulpho-defecation molasses (see Table V).

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[1] *Archief*, 1913, 313.

[2] *I.S.J.*, 1924, 480.

[3] Private communication.

[4] MULLER. *I.S.J*, 1921, 579

[5] BIRD. *La. Planter*, 1922, Vol. 69, 61; *I.S.J.*, 1923, 44.

B. Molasses.—Table V gives the results of some analyses made on different Natal and Mauritian molasses.

There is more variation in the figures for Mauritius than for those of Natal. This is to be expected when one takes into account the great diversity of Mauritian conditions already mentioned. There are about twice as much colloids in the Natal sulpho-defecation molasses compared to those of Mauritius. The difference between the Natal carbonatation and sulphitation molasses is very striking. Certainly carbonatation removes more colloids than sulpho-defecation. Considering the high figures obtained for the colloids in some Trinidad defecation molasses (1·5–2·0 per cent.) which had been made from ordinary cold limed juice, it would seem that sulpho-defecation removes more colloids than ordinary defecation.

Comparing the various constituents of the Natal molasses to those of Mauritius (Table V), we see that the total and colloidal pentosan is higher: so also is the colloidal silica. Colloidal nitrogen (protein), is about the same, but the total nitrogen of the Mauritian molasses is about double that of Natal and therefore must be due to excess amino-acids and amides which are dialysable. Column 7, Table V, shows this. The analyses of the molasses of the two countries bear out in general the observations made from the analyses of the juices.

Table VI gives an idea of the actual composition of the colloids from the different molasses.

There is a general similarity in the proportion of the different constituents: The amount of ash is high, being over 30 per cent. of the colloidal substance, most of it consisting of silica. There is no doubt of the existence of this substance amongst the colloids of the cane. Part of this silica appears to be in organic combination as suggested by MULLER, part in combination with lime. It is known that calcium silicate forms a colloidal solution in the presence of sucrose.[1] When the sucrose is removed by dialysis the calcium silicate precipitates. The same is also true of ferric hydroxide. Calcium sulphate (principally formed by oxidation of sulphite) is present in sulphitation molasses in finely dispersed form (possibly colloidal.) Both silicate and sulphate of lime accumulate when the molasses is constantly returned to the pan.[2] This is well shown from the analysis of the molasses from Highlands factory, Mauritius (Mauritius K.), where there is a certain amount of "boiling back." It appears that the very high amount of colloids (3·05 per cent.) consists largely of silicate and sulphate of lime.

Many constituents of the different molasses colloids could not be determined. Wax and tannin are known to be present. Galactan determinations were made on the colloidal substance from two different Mauritian molasses, but in neither case was any found. Therefore the gum recently described by GUPTA, SEN and WATSON[3] was absent.

A few wax estimations were made on some Natal molasses. The wax was determined by ether extraction. A 50 per cent. aqueous molasses solution was shaken in a separating funnel with successive portions of hot ether and the ether extract evaporated in a tared flask.

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[1] WEISBERG. *Bull Soc. Chim.* (Paris). (3) 1896, 15, 1097.

[2] GEERLIGS. "Cane Sugar and its Manufacture" (1909), p. 335.

[3] GUPTA and WATSON. *J. Soc. Chem. Ind.*, 1924, 43, 291; *I.S.J.*, 1924, 391.

TABLE V.

MOLASSES	1 Colloids per cent. Molasses	2 Total Pentosan per cent. Molasses	3 Colloidal Pentosan per cent. Molasses.	4 Per cent total Pentosan Colloidal	5 Total N × 6·3 per cent. Molasses.	6 Colloidal N × 6·3 per cent. Molasses	7 Per cent. total N × 6·3 Colloidal	8 Total Silica per cent. Molasses	9 Colloidal Silica per cent Molasses.	10 Per cent total Silica Colloidal
Natal—										
Mt. Edgecombe (carbonatation)	0·31	0·20	0·036	17·4	1·87	0·054	2·3	0·20	0·060	29·0
SULPHITATION										
A. Felixton	0·86	0·38	0·072	19·1	2·52	0·087	3·4	0·43	0·175	46·1
B. Empangeni	0·95	0·32	0·071	22·3	2·07	0·074	3·5	0·29	—	—
C. Ottawa	1·32	0·28	0·176	62·5	1·32	0·168	11·3	0·21	0·129	62·0
D. La Mercy	1·05	0·23	0·025	10·7	1·61	0·103	6·4	0·29	0·113	39·1
E. Esperanza	1·08	0·32	0·084	25·9	1·30	0·071	5·4	—	0·177	—
F. Renishaw	0·72	0·30	0·077	25·7	1·94	0·088	4·5	0·15	0·102	66·8
G. Tongaat	1·04	0·33	0·103	31·6	1·18	0·065	5·5	0·48	0·247	51·1
H. Tinley Manor	0·96	0·37	0·059	15·7	1·63	0·087	3·6	0·27	0·103	10·7
Average eight sulphitation	1·0	0·32	0·092	26·7	1·70	0·093	5·5	0·30	0·149	46·0
Mauritius—										
SULPHITATION.										
A. Medine	0·34	0·22	0·047	23·4	—	—	—	0·13	0·089	63·4
B. Britannia	0·26	0·30	0·038	12·5	4·28	0·048	1·1	0·11	0·047	43·4
C. Mon Desert*	0·45	0·30	0·037	12·2	4·66	0·064	1·4	0·40	0·142	29·6
D Union Flacq	0·44	0·14	0·041	29·9	2·96	0·062	2·1	0·51	0·045	8·8
E. Labourdonnais	0·34	0·18	0·063	35·6	2·11	0·064	3·0	0·50	0·039	7·7
F. Rose Belle	0·93	0·39	0·070	17·8	4·88	0·198	4·0	0·29	0·082	28·3
G. Trianon	0·28	0·22	0·080	37·1	3·15	0·074	2·3	0·10	0·041	38·1
H. Saint Antoine	0·70	0·46	0·116	25·4	2·63	0·109	4·1	0·20	0·119	60·1
Average eight sulphitation	0·46	0·28	0·061	24·2	3·52	0·088	2·6	0·28	0·076	34·9

TABLE VI.

Molasses	1 Colloids per cent. Molasses	2 Pentosan per cent Colloid	3 Protein $N \times 6.3$ per cent. Colloid.	4 Ash per cent Colloid	5 Silica per cent Colloid	6 Ammonia Precipitate per cent Colloid.	7 Lime per cent Colloid	8 Undetermined	
Natal—									
Mt. Edgecombe (carbonatation)	0·31	11 5	17·6	31·4	19 2	—	—	39·5	
SULPHITATION.									
A. Felixton	0·86	8·4	10 1	28·2	20 4	1·2	2 7	53·3	
B. Empangeni	0·95	7·5	7 8	62·7	—	—	—	22·0	
C. Ottawa	1·32	13·3	12·7	18·3	9·8	3 2	2·3	55·7	
D. La Mercy	1 05	2·4	9·8	53·1	10·8	—	—	18·0	per cent. wax
E. Esperanza	1·08	7·8	6·6	21·8	16·4	2·6	—	63·8	
F. Renishaw	0·72	10 7	12·2	20·5	14·1	—	6·2	56·6	
G. Tongaat	1 04	10·2	6·2	29·3	23·7	0·6	—	54·3	
H. Tinley Manor	0 96	6·1	9·1	20 0	10·7	3·2	2 7	37·4	per cent. wax
Average eight sulphitation	1·0	8·6	9·3	31·7	15·1	2·2	3·5	45·1	
Mauritius—									
SULPHITATION.									
A. Medine	0 34	13·7	—	32·0	26 3	3·8	4·3	54 3	
B. Britannia	0 26	14 7	18·3	22·5	18 0	—	—	44·5	
C. Mon Desert*	0 45	8·2	14·0	41·5	31 6	2 3	4·3	36·3	
D. Union (Flacq)	0·44	9·3	14 1	55·7	10·2	—	—	20·9	per cent. SO_3
E. Labourdonnais	0 34	18 5	19·0	18·8	11·4	2·9	3 9	43·7	
F. Rose Belle	0·93	7·5	21·3	38·5	8·8	2·2	12 6	32·7	
G. Trianon	0·28	28 8	26·3	19 4	14·5	—	—	25 5	
H. Saint Antoine	0 70	16·6	15·5	22·7	17·0	1·2	2 4	45·2	
Average eight sulphitation	0·46	14·7	18 4	31 4	17·2	2·5	5·5	37 9	
K. Highlands ("boil back").	3·05	2 7	6·1	74 9	31·4	2·1	12·2	14 8	per cent. wax 9 per cent. SO_3

* Moka.

TABLE VII.

MOLASSES	Wax per cent. Molasses.
Natal—	
Sulpho-defecation, A. Empangeni	0·21
„ „ B. La Mercy	0·18
„ „ C. Renishaw	0·17
Carbonatation, Mount Edgecombe *A.*	0·12
„ „ „ *B.*	0·16
Trinidad—	
Defecation, Waterloo	0·26

There is only slightly less wax in the carbonatation molasses. RAULT (private communication), is at present studying the effect of carbonatation and sulpho-defecation on the removal of cane wax. It is interesting to see the high figure for the wax in the sample of Trinidad defecation molasses. The Trinidad cane does not contain so much wax as the Uba of Natal. Apparently sulphitation removes more wax than ordinary defecation. BROWNE[1] found a large quantity of wax in the substance precipitated from cane juice by the action of SO_2. In cold acid solution cane wax rises to the top of the juice by reason of the emulsified air bubbles. At one factory in Mauritius (Beauchamp) the sulphured juice (*pH* 4·1 to 4·4) runs into a large shallow tank, or *Bac portal*, divided into different compartments and provided with an overflow. The waxy scums rise to the top and are returned to the mill. For the successful working of the *Bac portal* it is essential that the emulsified air be retained in the juice. Consequently the tank is as near the mill as possible and the crusher juice itself is not sulphured, but mixes with the highly sulphured juice of the second mill (eleven-roller mill).

SMITH[2] has shown in Hawaii that wax is adsorbed by the precipitation of calcium phosphate.

The following Table (Table VIII) summarizes our present knowledge of the removal of cane colloids by different methods of clarification.

TABLE VIII.

	-DEFECATION --			
Colloid.	Cold Lime.	Hot Lime	Sulphitation	Carbonatation.
Pectin	+	+ (if *pH* 8 and over)	+	++
Pentosan	0	0	+	++
Albumin	+	++	+++	++++
Wax	+ (P_2O_5)	?++ (P_2O_5)	+++	+++
Silica	0 ?	++	++	+++
Total colloids	+	++	+++	++++

(+ = a certain amount of colloid is removed.)

The present Cuban grinding season has not been free from some labour troubles, either at factories or else in connexion with the transport arrangements. A strike of stevedores at Cayo Juan Santo led to mill workers going out in sympathy. Strikes have also occurred at Centrals Boston, Delicias and Chaparra, and they have resulted in the sugar cane planters of those mills formulating a demand for increased payment on their cane. Railway strikes have also been threatened because a demand for increased pay on the part of the men has been met by a refusal by the companies, mainly because the low price of sugar has had a depressing effect on business conditions. Needless to say, a railroad strike in Cuba in the height of the grinding season would constitute a serious injury to Cuban business.

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[1] BROWNE. La. Bulletin, No. 91.

[2] SMITH. Report of the Raw Sugar Technical Committee, Hawaiian Sugar Planters Association (1923); *I.S.J.*, 1924, 181, 266, 322.

Baltimore Meeting of the Sugar Section of the American Chemical Society.

The 69th Convention of the American Chemical Society was held at Baltimore in April of this year, and following are abstracts of some of the papers presented to the Sugar Section.

Physical examination of sugar juices.—*K. R. Lindfors.* Methods at present in use in sugar factory laboratories do not furnish any reliable information as to the efficiency of thick-juice or syrup filtration, or the advantages gained by treatment with filter aids or sulphitation. Apparent and real purity values mostly remain unchanged, and ash determination is of little value, as the material removed is mostly of organic nature. It is here proposed to introduce uniform methods for the expression of visible and colloidal turbidity, and to report these, as well as viscosity and surface tension, in terms conveying a definite meaning to the average sugar man. Thus it will become possible to compare variations in the work, and express the results obtained by other methods, at different plants, in exact figures.

Testing apparatus and method for determining the filtrability of raw sugars.—*Louis E. Dawson.* A pressure filtration apparatus is described which can be used in the study of various types of solutions, filter aids, decolorizing carbons and filter media, as well as for the study of the fundamental laws of filtration. It can be used for solutions varying in volume from 450 c.c. to 8¼ litres with a filtration area of 1, 2, 3, 4, 5, or 6 sq. ins. Pressures up to about 100 lbs. per sq. in. and temperatures at room temperature and above can be used. It is provided with a stirrer and other accessories needed to provide for the reproducible control of conditions. It is mounted on a portable stand. A method is described which gives reproducible results with samples (500 grms.) of raw and refined sugars in 50 per cent. solution containing 5 grms. of kieselguhr. The tests are carried out at a temperature of 85°C. and a pressure of 30 lbs. per sq. in. over a period of 30 mins. Results are given showing the reproducibility of the method, and the filtrability of eight samples of raw sugars and a high grade refined sugar are compared.

Colour standards for soft sugars.—*H. I. Knowles.* Soft or brown sugars are classified on a basis of the depth or amount of colour. Grading is usually accomplished by reference to standard soft sugars. As different grades of soft sugar have, within certain limits, different market values, soft sugar standards are of some importance and are of especial interest to the sugar refiner. The colour of soft sugar is apt to change quite readily. Standards made therefrom are not reasonably permanent; moreover, they cannot be easily duplicated. For these reasons the writer attempted to make artificial soft sugars and found that coarse powdered grades of granulated sugar, pigments and Russian oil when mixed gave a good imitation soft sugar which experience has shown is reasonably permanent and practicable in application. The preparation of standards from these materials is described.

Temperature and analytical changes in sugar liquor during boneblack filtration.—*H. I. Knowles.* The distribution of boneblack in a filter, not provided with a mechanical distributor, is shown by screen analysis of char taken during the filling of the filter. Temperatures of liquor at certain points at the side and middle of the filter during operation are shown; and colour absorption by the char at the side, middle, and at a point halfway between, at three different elevations of the filter, is compared, the rate of flow of liquor at the three different points in the filter being indicated. Further, analyses of approximately the same liquor, sampled at three places on its journey through the filter (down the side, down the middle and down a section halfway between) are presented. From the results of tests, the drop in *pH* during filtration is shown and the proper *pH* at which liquor should be kept to prevent loss of sucrose by inversion is indicated; while the importance of proper char distribution when filling the filter is brought out.

Invertase hydrolysis constants for sucrose and raffinose.—*H. S. Paine and R. T. Balch.* Recent advances in methods of sugar analysis depending upon hydrolysis by enzymes emphasize the importance of precise evaluation of the enzyme hydrolytic constants. The invertase inversion constants of carefully purified sucrose were determined at frequent intervals of sucrose concentration over the range 2·5 grms. to 26·0 grms. sucrose per 100 c.c. at 20°C. Four invertase preparations of the relative activities 1, 6·5, 12, and 29 were used and the temperatures of inversion varied from 20°C. to 47°C. The relation of the inversion constants to sucrose concentration is expressed by the linear equation: inversion constant $= 131{\cdot}18 + 0{\cdot}0728\ c$, where $c =$ the number of grms. of sucrose per 100 c.c. The data obtained by using invertase preparations of varying activity at different temperatures of inversion under otherwise identical conditions were concordant. The average raffinose hydrolysis constant (ratio of polarization after invertase hydrolysis to the original polarization) was found to be 0·521 at 20°C. for a range of direct raffinose polarizations varying from a minimum of 17·4° to a maximum of 63·2° Ventzke in a 2 dm. tube; the variation in this constant is is extremely small for the range mentioned.

The relation of structure to rotatory power in the sugar group.—*C. S. Hudson.* The discovery of the two isomeric forms of methyl glucoside by EMIL FISCHER in 1893 proved that one of the asymmetric carbon atoms of glucose has a mobile structure. In 1909 the author advanced a theory by which the optical rotatory power of the methyl glycosides and many other substances of the sugar group could be correlated with the structure of this carbon atom. Since then a large number of experimental researches have shown that this correlation is well founded and that it can be used to determine the molecular structure of many carbohydrates. The present address is a presentation of the results of these researches in the form of a general review and a summary of the principal conclusions.

Fermentation in the syrup phase of certain types of confectionery and means of controlling same.—*H. S. Paine and J. Hamilton.* The variation in the solids content of the syrup phase of various grades of fondant or 'cream' confections, as determined by the composition of the batch, was investigated in view of the general observation that the tendency of syrups to undergo fermentation diminishes with increase in density. Fermentation of this type of candy causes a considerable annual loss to the confectionery industry. 'Hand rolled' creams are more subject to fermentation than 'cast' creams; the former contain higher proportions of sucrose and the solids content of the syrup phase may vary approximately from 68 per cent. to 75 per cent., while the latter contain higher proportions of commercial glucose and the solids content of the syrup phase may reach 81 to 82 per cent. The solids content of the syrup phase of fondant confections of high initial sucrose content may be increased to approximately 83 per cent. through inversion of a portion of the sucrose by the enzyme invertase. The latter is added in regulated amount designed to produce inversion at the rate desired after the goods are coated with chocolate.

Effect of Certain Factors on the Candy Test of White Cane and Beet Sugars.[1]

By H. S. PAINE, M. S. BADOLLET, and J. C KEANE.

CANDY TESTS.

The so-called "candy test" was applied to a number of samples of ordinary granulated sugar and various comparative tests were made of the sugars and resulting " barley " candies. This test, which reproduces the maximum conditions of temperature employed in manufacture of hard candy, was applied in the following form.

In a 750 c.c. porcelain casserole were placed 227 grms. of sugar and 87 c.c. of water, and the mixture heated at such a rate that a temperature of 176·7°C. (350°F.) was attained in 30 minutes. The resulting dense syrup was poured in an iron frame resting on a stone slab in such a manner as to produce a rectangular 12·7 × 15·2 cm. (5 × 6 in.) piece of hard candy of practically uniform thickness.

An approximate comparative record of the colour of the various candy pieces was made by means of a Lovibond tintometer, and observations were also made regarding rate of initial sucrose crystal formation and rate of propagation of crystallization through the candy mass.

The candy was then broken up and the direct polarization of sucrose normal weight solutions at 20°C. was determined. The table below shows the values of a number of criteria applied comparatively to the various sugars and the hard candies made therefrom; each sample of sugar and the corresponding candy are designated by the same number.

MATERIAL	Sucrose normal weight polarization ° V,	pH (colorimetric)	σ Dynes per cm.	Reducing substances calcd. as invert sugar Per cent
Sugar 20	99·75	7·35	56·0	None
Candy 20	96·19	6·7	54·6	1 08
Sugar 21	99·71	7·30	55·8	None
Candy 21	95·65	5·9	55·3	1 20
Sugar 22	99 72	7·35	59 6	None
Candy 22	94·85	5·3	55·2	1·51
Sugar 23	99·67	6·40	60·8	0·05
Candy 23	93·35	5·2	57·0	3 46
Sugar 24	99·71	6·30	70·5	Trace
Candy 24	94 35	5·6	58·0	2·64
Sugar 25	99·74	6·60	68·3	None
Candy 25	96·00	5·7	57 9	0 96
Sugar 26	99·74	6·50	62·8	Trace
Candy 26	92 45	5·7	55 2	3 93

Examination of the data in the table shows that there was exceedingly little difference in the normal weight polarizations of the various samples. Hard candy prepared from sugar with highest *pH* generally had a higher normal weight polarization than that made from sugar with low *pH* value. Sugars of lower *pH* and candies made therefrom usually contained a greater proportion of reducing substances than sugars of higher *pH* and their resulting candies; this relation is correlative with that existing between the normal weight polarizations.

The *pH* value of the hard candy was always considerably less than that of the sugar from which it was produced. The decrease in *pH* is evidently due to production of organic acid-reacting substances resulting possibly in part from destruction of sucrose, accompanied by inversion and, at a later stage, destruction of dextrose and fructose. As the *pH* decreases the rate of inversion increases and, since levulose especially is readily decomposed with formation of acid products, the *pH* further decreases and thus the interaction of these factors continues. The candy of highest *pH* value (6·7) was obtained from sugar of *pH* 7·35 (the highest value observed), but the general relation between the *pH* values of sugar and candy is not fully apparent, e.g., it is not certain whether the net formation of acid products from sucrose, dextrose, and levulose is accelerated more by a slightly alkaline than by a slightly acid reaction, or *vice versa.*

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[1] Extracted from the Authors' paper "Colloids in Cane and Beet Sugar Manufacture"; See *I.S.J.*, 1925, 147-152; 210-214.

The σ values of the hard candies varied less than those of the corresponding sugars, high surface tension being reduced to the general level of the lower ones. This is probably due to the formation of highly dispersed emulsoid caramelization products, which depress surface tension. A rather dilute solution of caramel (prepared from sucrose) had a surface tension of 54·3 dynes per centimetre, and, when added to a sucrose solution, depressed the σ value of the latter. The colour of the candies increased in the following order; 25-24-20-26-21-23-22.

The time periods required for initial formation of sucrose crystals in the candies varied in general in inverse order to the normal weight polarizations of the latter: the rate of propagation of crystallization decreased with decreasing polarization. The proportion of reducing substances present evidently had a determining influence on sucrose crystallization in the hard candies.

Crystallization in the hard candies usually proceeded from the surface inward, although in some instances the initial sucrose crystals were produced in the interior of the mass. Some of the crystallization phenomena were very striking; in one instance initial sucrose crystals were produced practically simultaneously on the two opposite faces of the rectangular mass and the two opposing crystallization waves proceeded at almost the same rate, meeting at a nearly half-way point in a slightly irregular line of demarcation. Inasmuch as the boiling points of sucrose solutions of increasing concentration form a curve (b. p. $= (f)$ sucrose concentration) which may be smoothly extrapolated to include the melting point of sucrose, such hard candies may be regarded as supercooled melts in which the small proportion of water[1] present acts as an impurity regulating the time required for initial crystal formation and the rate of crystal propagation.

The rate of crystallization in the hard "barley" candies in the above table is probably influenced more by the invert sugar present than by the colloids, although it must be remembered that, in addition to the colloids of the sugar, the decomposition products resulting from heating to 176·7° C. (350° F.) are predominantly of colloidal character (probably highly dispersed emulsoids). The various factors discussed in connexion with the experimental "barley" candies are of great importance in commercial hard candy manufacture. This general subject has been introduced here for the purpose of making certain comparisons between sucrose in crystal form and sucrose in the form of an amorphous, supercooled melt.

The present investigation indicates that the *pH* value (measured colorimetrically in 26 grms. per 100 c.c. solution[2]) of beet sugars is usually greater and that of cane sugars less than 7·0. In other words, the electrolytes of beet sugar have a slightly alkaline and those of cane sugar a slightly acid predominant reaction. It is desirable in this connexion to test cane sugar made by the double carbonatation process, and the writers hope soon to have this opportunity. It is uncertain just what influence, if any, the colloids exert indirectly on the *pH* value of the granulated sugar solutions, as a result of the poorly buffered condition of the latter.

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[1] Compare in this connexion the accelerating influence of small proportions of water (adsorbed from the atmosphere) on crystallization of commercial hard candies from the surface inward; hence the increasing use of "moisture-proof" packages. In commercial hard candy manufacture the sucrose is partially inverted with cream of tartar or corn syrup is added, the invert sugar and corn syrup dextrins serving to retard sucrose crystallization; however, invert sugar and dextrins are hygroscopic, so that their influence on sucrose crystallization is both accelerating and retarding, the latter being usually predominant.

[2] Since the electrolyte content of granulated sugar is very small, and the solution is poorly buffered, the *pH* value of the latter is exceedingly sensitive to absorption of atmospheric carbon dioxide.

The importance of the *pH* value in determining adsorption of colloids on the sucrose crystals now becomes apparent. The *pH* value may also be of importance in determining the colour of adsorbed or otherwise retained pigments; practically all these pigments are also to be regarded as colloidal, so that the pH value may influence them in a twofold manner.

Laboratory Experiments determining the Inversion Losses in Cane Sugar Manufacture.[1]

By C F WALTON, Jr., M. A. McCALIP, and W F. HORNBERGER,
Carbohydrate Laboratory, Bureau of Chemistry, Washington, D C.

PURPOSE OF THE INVESTIGATION.

For several reasons it has been difficult to investigate inversion in the factory, one concerning the taking of corresponding samples throughout the process, and the other the fact that few sugar-houses have laboratories sufficiently well equipped for the study of such a problem. As the result of these difficulties, little reliance has been placed in the past on such analytical data as have been reported on chemical control sheets, which might or might not be considered indicative of inversion.

Procedures which have been used in the laboratory for determining inversion have been subject to criticism because they have not accurately reproduced operating conditions. In other words, the changes of acidity and sucrose concentration occurring in the manufacturing operations have not been duplicated, nor have time and temperature been given proper consideration.

On the other hand, in this study[2] certain definitely specified conditions, in respect especially of temperature and time, known to exist commonly in practice have been arbitrarily selected, these being briefly as follows:—

LABORATORY DUPLICATION OF FACTORY PROCEDURE.

Defecation.—The *pH* value was adjusted by the addition of sulphurous or phosphoric acid, or milk-of-lime. In most of the defecation experiments, the factory temperature duplicated was 100·5 to 93°C. (213 to 199·4°F.) over a period of 4 hours, the samples being rapidly heated to boiling over a flame to duplicate the effect of passing the juice through a heater.

Evaporation to syrup.—Use was made of a single effect evaporator (a laboratory triple effect not being available), the total time allowed for evaporation being 1 hour and 45 min. During the first 35 min., the temperature was 82°C. at 368 mm. (14·5 in.) of vacuum, for the second 35 min., 71°C. at 521 mm. (20·5 in.), and for the third 35 min., 60°C. at 622 mm. (24·5 in.) vacuum. Four litres of juice yielded about 1000 c.c. of syrup at 50° Brix.

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[1] *Industrial and Engineering Chemistry*, 1925, 17, No 1, 51-56, here abridged considerably. A short abstract of this important paper has already appeared; *I.S.J.*, 1924, 312.

[2] Juice used was sent to Washington from Louisiana, having originally been packed hot in 5-gall. cans Immediately on receipt it was placed in cold storage, under which conditions it kept perfectly.

Boiling syrup to massecuite.—Time taken for a first strike was 4·5 hours; maximum temperature for graining was 73°C., the minimum 67°C., and the average 69°C. For a second strike massecuite, the average temperature in the pan was 60°C., and a two-hour period was required to concentrate from 54·4 to 91·2° Brix. The time in the crystallizer was four days, the temperature being reduced during this time at a definite gradient from 60 to 35°C.

DISCUSSION.

Referring to Table I, and allowing for maximum experimental error, inversion during the defecation of limed juice is not definitely apparent until the initial *pH* of the juice is reduced to 6·1. In Experiment 2, Table I, the percentage of sucrose decreased from 12·18 to 12·13, a difference sufficiently greater than experimental error to justify the conclusion that inversion had occurred; while confirmation is found in the increase of the glucose ratio from 8·213 to 8·673. In Experiment 1, Table I, the percentage of sucrose decreased from 12·21 for the blank to 12·19 for the sample of which the *pH* was 6·5. Although this difference is not in excess of experimental error, the glucose ratio increased from 8·059 to 8·367. Moreover, in Experiment 3 the sample of initial *pH* 6·65, and in Experiment 2 the sample of initial *pH* 6·7, showed the maximum decrease in sucrose attributable to experimental error, and likewise the maximum increase in glucose ratio. Although a single experiment might not furnish conclusive evidence, since the variation in percentages of sucrose and glucose during defecation in these experiments was always in the same direction, it is apparently safe to conclude that the border line close to which a slight degree of inversion takes place is approximately *pH* 6·7. Referring to Experiment 4, Table I, the conclusion seems warranted that no inversion occurred in the defecation of sulphur lime-juice.

In the experiments listed in Table II unusual conditions obtained. In Experiment I the initial apparent solids content was 17·9° Brix, instead of approximately 15° Brix, as for the experiments reported in Table I. Although only one experiment at this density is reported, the data indicate that some inversion occurred even in the sample designated "blank defecated," which possessed an initial *pH* of 7·1. Although it is not safe to conclude from the results of one experiment that an increase in degrees Brix from 15 to 17·9 is solely responsible for the observed inversion at higher *pH*, it is true that the inversion velocity increases at higher sucrose concentrations.

In Experiment 2, Table II, the conditions differed markedly from those applying to the experiments in Table I, in that the period of heating was purposely increased to 18 hours to approximate roughly the temperature condition which would obtain in the defecation of juice by use of the Dorr clarifier. In operating this apparatus it is estimated that, although most of the juice remains in it for a comparatively short time, possibly 6 per cent. of the total volume handled is retained for as long as 18 hours, and possibly as much as 2 or 3 per cent. remains in the clarifier for an even longer period, this juice being that which remains in the bottom before the muds are drawn off. It has been observed in practice that juice becomes more acid the longer it remains at a relatively high temperature, and the results of this experiment show that the *pH* decreased from a value as high as 8·25 to one of 6·35 at the end of the 18-hour period. The inversion in this experiment was undoubtedly greatly in excess of experimental error. The density of the juice, however, increased somewhat owing to evaporation, and it cannot be concluded that the same degree of inversion would occur

Laboratory Experiments determining Inversion Losses.

Table I—DEFECATION OF JUICE

Expt	Material	Colorimetric *pH*		Acidity (Cc 0·1 *N* NaOH per 10 Cc of Sample)		°Brix by hydrometer	Direct polarization °V	Sucrose by invertase method %	Glucose %	Glucose ratio	Weight			Weight of glucose and sucrose Grms	Calcd to sucrose equivalent Grms	Loss of sucrose %
		Before defecation	After defecation	Before defecation	After defecation						Juice Grms	Sucrose Grms	Glucose Grms			
							Limed Juice									
1	Blank . .	7·10	—	0·15	—	15·00	11·83	12·21	0·983	8·059	534·39	65·249	5·253	70·502	70·339	—
	Blank defecated	7·10	6·65	0·25	0·35	15·00	11·83	12·20	0·987	8·090	534·59	65·220	5·76	70·496	70·232	0·04
	Sample+H_3PO_4	6·50	6·30	0·40	0·50	15·00	11·81	12·19	1·020	8·367	534·42	65·148	5·451	70·599	70·336	0·15
2	Blank (not analysed)															
	Blank defecated	7·10	7·00	0·25	0·35	15·00	11·83	12·18	1·000	8·213	534·27	65·074	5·343	70·417	70·150	—
	Sample+H_3PO_4	6·70	6·50	0·45	0·50	15·00	11·79	12·15	1·026	8·444	534·73	64·970	5·486	70·456	70·182	0·16*
	Sample+H_3PO_4	6·10	6·10	1·05	1·05	15·00	11·75	12·13	1·052	8·673	534·92	64·886	5·627	70·513	70·232	0·29*
3	Blank	8·25	—	—	—	15·50	11·96	12·28	0·960	7·817	534·50	65·637	5·131	70·768	70·511	—
	Blank defecated	8·25	6·50	Neutral	0·35	15·50	11·97	12·25	0·955	7·796	534·53	65·480	5·105	70·585	70·330	0·24
	Sample+H_3PO_4	6·65	6·50	0·35	0·40	15·50	11·91	12·25	0·995	8·122	534·80	65·513	5·321	70·830	70·568	0·19
							Sulphur Lime Juice									
4	Blank .	6·90	—	0·60	—	14·53	11·80	12·08	0·734	6·076	479·00	57·863	3·516	61·379	61·203	—
	Sample+H_3PO_4	6·80	—	0·60	—	14·53	11·79	12·08	0·736	6·093	478·92	57·854	3·525	61·379	61·203	0·02
	Sample+H_3PO_4	6·70	—	0·65	—	14·53	11·79	12·07	0·745	6·172	479·10	57·827	3·569	61·369	61·218	0·06

* The blank was not analysed and the sucrose losses have been calculated on the basis of the "blank defecated"

Table II.—DEFECATION IN LIMED JUICE[1]

Expt.	Material	Colorimetric *pH*		Acidity (Cc 0·1 *N* NaOH per 10 Cc of Sample)		°Brix by hydrometer	Direct polarization ° V	Sucrose by invertase method %	Glucose %	Glucose ratio	Weight				Calcd to sucrose equivalent Grms	Loss of sucrose %
		Before defecation	After defecation	Before defecation	After defecation						Juice Grms	Sucrose Grms	Glucose Grms	Glucose and Sucrose Grms		
1	Blank	7·10	—	0·25	—	17·90	13·97	14·46	1·172	8·105	540·70	78·185	6·337	84·552	84·205	—
	Blank defecated	7·10	6·30	0·25	0·60	17·90	13·91	14·42	1·225	8·495	540·71	77·430	6·624	84·045	83·723	0·97
	Sample+H_3PO_4	6·10	5·90	1·05	1·25	17·90	13·68	14·22	1·446	10·169	540·72	76·890	7·819	84·707	83·318	1·66
	Sample+H_3PO_4	5·70	5·70	1·65	1·70	17·90	13·48	14·08	1·545	10·973	540·77	76·140	8·355	84·495	84·077	—
2	Blank .	8·25	—	Neutral	—	15·50	11·96	12·26	0·965	7·871	534·50	65·530	5·158	70·688	70·430	2·62
	Blank defecated	8·25	6·35	Neutral	0·60	15·50	11·73	12·01	1·133	9·434	534·61	64·207	6·057	70·264	69·961	2·02
	Sample+H_3PO_4	7·15	6·15	0·25	0·80	15·50	11·14	11·55	1·632	14·130	534·50	61·735	8·723	70·458	70·022	5·79
	Sample+H_3PO_4	6·65	6·15	0·35	0·83	15·50	11·37	11·76	1·485	12·628	534·10	62·810	7·931	70·741	70·344	4·15
3	Blank	8·25	—	Neutral	—	15·00	11·81	12·19	0·990	8·121	534·60	65·168	5·293	70·461	70·196	—
	Blank defecated	8·25	—	Neutral	1·80	15·00	5·73	7·02	5·925	84·402	534·73	37·538	31·683	69·221	67·637	42·40
	Sample+H_3PO_4	6·65	—	0·40	1·65	15·00	7·71	8·71	4·358	50·034	534·50	46·555	23·294	69·849	68·684	28·56
	Sample+H_3PO_4	7·15	—	0·20	1·70	15·00	7·14	8·20	4·819	58·768	534·52	43·831	25·759	69·590	68·302	32·74

[1] Unusual conditions See Discussion

in ordinary practice. In order to determine this question more definitely it is necessary to repeat the experiment, taking care that no appreciable evaporation occurs. Experiment 3, Table II, shows an even greater degree of inversion because juice samples were kept in the oven for 40 hours and the concentration was increased by evaporation to approximately that of a thin syrup.

In all the defecation experiments the increase in *pH* determined colorimetrically was readily detectable, the greatest change being apparent in those samples in which the initial titrated acidity was smallest and the *pH* correspondingly highest. This is shown in Experiment 3, Table I, and in Experiment 2, Table II. As an explanation of this increase in acidity, the theory may be advanced that a greater destruction of glucose and possibly of other substances in the juice takes place with the formation of acid products when the samples are originally close to phenolphthalein neutrality than when they are somewhat more acid in reaction.

The data reported in Table III indicate that, in the combined defecation of limed juice and evaporation to syrup under conditions comparable to factory practice, no degree of inversion greater than that attributable to experimental error can be inferred. The *pH* value, however, was practically the same in all these experiments with limed juice, and it is desirable also to secure data for samples having a higher initial acidity. In the experiments on defecating sulphur-lime juice and evaporating it to syrup, inversion was clearly indicated when the initial *pH* was 5·9 and the titrated acidity 1·25, the glucose ratio increasing and the true purity decreasing by amounts greater than the experimental error. Some inversion is also indicated in those experiments in boiling SO_2 lime juice to syrup when the initial *pH* values for the juice were 6·20 and 6·45, respectively. When the *pH* value of the juice was 6·7, little inversion, if any, occurred.

The results of the sugar-boiling experiments reported in Table IV indicate that in boiling raw sugar syrup to massecuite inversion takes place when the *pH* of the syrup (measured at 15° Brix) is as high as 6·5, the true purity decreasing from 84·49 to 83·73; that is, by more than the experimental error. Agreement between true purities is exceptionally close in the experiment in which the *pH* of the syrup is 7 0, and in this case no inversion is indicated. When the *pH* value of the syrup is 6·7, the decrease in true purity is somewhat less than the experimental error, being only 0·35, but this decrease is intermediate between the results of the other two experiments. It is possible to explain the close agreement in glucose ratios on the assumption that slight destruction of glucose occurred during the experiment. Comparing the data of these three experiments, the *pH* value 6·7 for raw sugar syrup appears to represent the boundary line at which there is only slight inversion, if any, but below which inversion becomes definitely apparent.

In the experiments on boiling sulphur-lime syrup to massecuite, also reported in Table IV, no inversion occurred, even when syrup of *pH* value as low as 6·0 was used. In Table V two experiments are recorded in which sulphur-lime syrup at approximately 50° Brix was boiled at atmospheric pressure for 15 mins., and subsequently kept on the steam-bath for 4 hours to duplicate approximately the practice of "cleaning" the syrup in a brush-pan in those factories operating to produce first sugar and a high grade first molasses. No inversion occurred when the *pH* value of the syrup was 6·8 and the titrated acidity 0·45, whereas, when the *pH* of the syrup was 5·95 and the titrated acidity 1·45, the increase in glucose ratio and decrease in true purity clearly indicated appreciable inversion.

Table III.—COMBINED DEFECATION OF JUICE AND EVAPORATION TO SYRUP.

MATERIAL	Colorimetric *pH*	Acidity (cc 0.1 *N* NaOH per 10 cc. of samples at 15° Brix)	°Brix by hydrometer	Solids by drying %	Direct polarization °V.	Sucrose by invertase method %	Glucose %	Glucose ratio	Apparent purity %	True purity %
					Limed Juice to Syrup					
Juice	6·90	0·28	14·95	14·16	11·51	11·86	0 973	8 221	76·99	83·76
Syrup	6·50	0·40	53 45	51 96	42 45	43 31	3 630	8·381	79·42	84·51
Juice	6·90	0·30	14 75	14 11	11·45	11·81	0·973	8·239	77·66	83·68
Syrup	6·50	0·38	37 50	36 47	29 85	30·58	2 531	8·277	79 60	83 84
Juice	7·07	0·20	14 45	13 75	11 19	11·52	0 944	8·191	77·44	83 81
Syrup	6·60	0 33	46·70	45 43	37 05	38 07	3 108	8 164	79·34	83·80
					Sulphur-Limed Juice to Syrup					
Juice	5 90	1 25	15 00	14 49	10·70	11 19	2·175	19·437	71 35	77·23
Syrup	5 90	1 05	56·08	54 25	39·69	41·54	8·425	20·282	70 77	76·57
Juice	6·45	0 85	15 00	14 49	10 93	11 37	1 960	17 235	72·86	78 47
Syrup	6 20	0 90	52 20	51 11	38 25	39 95	7·068	17 692	72·72	78·16
Juice	6·20	—	15·20	14 49	10 67	11·25	1 953	17·360	70·20	77·63
Syrup	6·20	—	55 41	53 69	39·60	41 60	7 361	17·695	71·47	77·48
Juice	6·70	0 75	15·28	14·54	10·72	11 33	1·961	17 308	70·16	77·92
Syrup	6·50	0 85	57 94	56 13	41·73	43 69	7 615	17 430	72·02	77·84

Table IV.—RESULTS OF SUGAR BOILING EXPERIMENTS.

MATERIAL	Colorimetric pH	Acidity cc. 0.1 *N* NaOH per 10 cc of sample at 15° Brix)	°Brix by hydrometer	Solids by drying %	Direct polarization °V	Sucrose by invertase method %	Glucose %	Glucose ratio	Apparent purity %	True purity %	REMARKS
					Raw Sugar Syrup to Massecuite						
Syrup	6·50	—	47 20	45 85	37·65	38·74	3 157	8 149	79·77	84·49	
Massecuite	6·50	—	46·86	45·61	37 25	38 19	3 118	8 164	79 49	83·73	Double diluted
Syrup	6 70	0·32	57·35	55 82	45 74	46 95	3 804	8 102	79·76	84 11	
Massecuite	6·60	0·32	47·06	45 93	37 62	38·47	3 146	8 178	79·94	83·76	Double diluted
Syrup	7 00	0 20	54 14	52·48	43·25	44·21	3 494	7 901	79 88	84·24	
Massecuite	6 80	—	45 56	44 07	36 22	37·11	2 983	8·038	79 50	84·21	Double diluted
					Sulphur-Limed Syrup to Massecuite						
Syrup	6·00	1·32	53·05	51 44	38 47	40 36	6 896	17·086	72·52	78·46	
Massecuite	6 25	0·90	46·96	45·38	34·10	35 66	6 068	17·002	72 61	78·57	Double diluted
Syrup	6·05	1·30	55·95	53 97	40 55	42·35	7 322	17 289	72 46	78·47	
Massecuite	6·30	0 90	47·22	45·73	34 53	35 95	6 194	17 234	73 13	78·61	Double diluted
Syrup	6·45	0·85	56·00	54 43	40 80	42·71	7 361	17 235	72·86	78·47	
Massecuite	6·50	0·75	47 20	45·76	34 50	35·95	6 165	17·149	73·09	78·56	Double diluted
Syrup	6·80	0·55	55·20	53·43	40·05	41·81	7·263	17·371	72·55	78·26	
Massecuite	6·85	0·55	47·87	46·42	34 84	36·39	6·178	17 203	72·78	78·39	Double diluted
Syrup	6·90	—	58 68	58 21	49·85	50·71	2·375	4 683	84·95	87·12	
Massecuite	6·90	—	88·56	87·48	75 30	76·28	3·570	4·680	86·13	87·20	

Table V.—RESULTS OF BRUSH PAN EXPERIMENTS (SULPHUR-LIME SYRUP).

MATERIAL	Colorimetric *pH*	Acidity (cc. 0.1 *N* NaOH per 10 cc. of sample at 15° Brix)	°Brix by hydrometer	Solids by drying %	Direct polarization ° V.	Sucrose by invertase method %	Glucose %	Glucose ratio	Apparent purity %	True purity %
Syrup, original	6·80	0·55	55·20	53·42	40·05	41·81	7·268	17·371	72·55	78·26
Syrup heated	6·60	0·62	56·50	54·80	41·22	43·00	7·427	17·272	72·96	78·47
Syrup, original	5·95	1·45	56·68	55·09	41·15	43·05	7·579	17·605	72·60	78·14
Syrup, heated	5·90	1·25	56·92	54·99	40·61	42·46	8·255	19·442	71·35	77·21

Table VI.—BOILING 60° PURITY MOLASSES BLANK.

MATERIAL	Colorimetric *pH*	Acidity (cc. 0·1 *N* NaOH)	°Brix by hydrometer	Solids by drying %	Direct polarization °V.	Sucrose by invertase method %	Glucose %	Glucose ratio	Apparent purity %	True purity %
Molasses	5·90	—	54·44	50·79	31·55	33·81	7·12	21·059	57·95	66·57
Massecuite	—	—	91·22	85·82	54·73	57·55	12·05	20·937	60·00	67·6

Temperature in crystallizer:
After 24 hours, 53·5° C.
After 40 hours, 48·0° C.
After 64 hours, 43·0° C.
After 4 days, 35·0° C.

Table VI gives the results of an experiment on boiling molasses blank and then placing it in a crystallizer. The *pH* of this material, measured at 15° Brix, was 5·9, which is as low as in any samples of molasses resulting from the sugar boiling experiments in which no inversion occurred. The close agreement between both the glucose ratio and true purity for molasses and the resulting massecuite indicates that no detectable inversion occurred during this experiment.

Whenever the quinhydrone electrode was used to determine the *pH* value of samples of syrup directly, without diluting below 40° Brix, the *pH* value found was always lower than that for the same sample after dilution to 15° Brix. A variation from *pH* 6·36 for syrup at 46° Brix to *pH* 6·61 for the same syrup at 15° Brix represents a typical difference. This variation probably represents the net result of differences in acid concentration and dissociation and likewise of hydrogen-ion activity, since the volume concentration of both acid and sucrose is greater at the higher Brix. This relation should be kept in mind in factory procedures during which water is progressively evaporated.

In boiling syrup to massecuite, the acidity is greater than that of the juice from which the syrup is derived, although, of course, the temperature is lower than during defecation. If boiling raw sugar syrup of *pH* 6·7 measured at 15° Brix, corresponding to *pH* 6·35 at 50° Brix, gives results indicative of inversion, it is obviously not necessary for the purpose of this investigation to study the defecation of juice of such initial *pH* that it will yield syrup of the *pH* value mentioned.

It would seem rather that the initial *pH* value of the juice should be such that when this same juice is evaporated to syrup, the syrup can be boiled to massecuite without inversion. Reasoning along this line, the data obtained indicate that, in defecating juice for raw sugar manufacture, the initial *pH* at which it is safe to carry the juice lies between 7·0 and 8·0;[1] in other words, at such a point that this juice, when evaporated to syrup, will possess a *pH* (measured at 15° Brix) lying between 6·7 and 7·0.

In the sulphitation process, by which direct consumption sugar is produced, it is indicated that a lower *pH* and correspondingly higher titrated acidity may be safely carried. The sulphites present in these sugar-house liquors apparently retard the progressive increase in acidity by the decomposition of glucose, and may also possess a specific inhibiting property in the inversion of sucrose. Investigation of the specific influence of sulphites on *pH* measurement (both colorimetric and electrometric) is required for fuller explanation of this matter.

Dr W. H. HADFIELD recently described[2] new corrosion-resisting steels suitable for engineering purposes He said that attempts to produce such metals by adding small percentages of various elements had proved ineffective, and only by the use of substantial amounts of chromium or nickel could the object be achieved. With a chromium content of 13 to 14 per cent., and a carbon content ranging from 0·35 per cent. down to under 0·10 per cent., an extremely valuable series of steels, which were resistant to most atmospheric and food influences was produced. Such steels suitable for purposes requiring the characteristics of hardened steel, the machining and mechanical properties for engineering purposes, or a substantial ductility as required for many minor purposes, might be obtained. However, the resistance of steel was naturally only satisfactory as regards a limited range of corroding media. If, along with the still higher chromium content, a substantial proportion of nickel be added, complete resistance to a much wider range of corroding media was obtained.

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[1] This is in substantial agreement with MCALLEP's conclusions, *Louisiana Planter*, 1924, 72, 114.

[2] *Engineer.*

Manufacture of Sugar direct from Cane in India.[1]

Twenty-three factories making sugar direct from cane worked in India during the season 1923-24 as compared with 19 in the season 1922-23 and 18 in 1921-22. Eleven[2] of these factories are situated in the province of Bihar and Orissa, eight in the United Provinces of Agra and Oudh, two in Madras and one each in Assam and Bombay. Enquiries were instituted by the Sugar Bureau to ascertain the output of these factories, and we are much indebted to the management of these factories for their courtesy in furnishing the statistics required under various heads.

The table below shows the total amount of cane crushed and sugar made by the factories in (1) Bihar and Orissa, (2) United Provinces and (3) other provinces of India. The production of sugar direct from cane by modern factories in India totalled 1,044,855 maunds[3] or 38,312 tons during the season 1923-24 as compared with 651,415 maunds or 23,886 tons in the season 1922-23.

Provinces.	Cane crushed in maunds.		Sugar made in maunds		No of factories working.	
	1922-1923	1923-1924.	1922-1923	1923-1924	1922-23.	1923-24
Bihar and Orissa	4,770,721	6,738,391	377,292	509,547½	9	11
United Provinces of Agra and Oudh	2,461,397	5,258,728	171,272	368,790½	6	8
Other Provinces of India	1,423,256	1,996,917	102,851	166,517	4	4
TOTAL FOR INDIA	8,655,374	13,994,036	651,415	1,044,855	19	23

A study of the statistics will show that there was an increase of 5,338,662 maunds in the quantity of cane crushed and of 393,440 maunds in the amount of sugar produced by factories in India during the season 1923-24 as compared with 1922-23. This increase in all the provinces was due mainly to the fact that factories could obtain more cane for milling in the season 1923-24. It may be mentioned here that, in the season 1923-24, the area under sugar cane in India was 169,800 acres greater than in the previous season.

If we take the all-India figures we find that 13·39 maunds of sugar cane were required in the season 1923-24 to produce one maund of sugar as compared with 13·28 maunds required in the previous season. This was due to the fact that some of the factories in the United Provinces were so overwhelmed with cane that they had to put it through the mills much faster than usual in order to take off this crop.

During the season 1923-24, India's production of molasses by modern factories making sugar direct from cane totalled 622,473 maunds as against 348,024 maunds in the previous season. The increased production should naturally result in a reduction to that extent of the imports of foreign molasses into India unless consumption shows an increase in this country.

According to *Commerce Reports*, the Hawaiian sugar harvest is going ahead full speed. On February 28th approximately 230,000 short tons, or 35 per cent. of the estimated total of the new crop, had been harvested, as compared with 205,000 at the same time last year and 148,000 two years ago. During February 60,500 tons of sugar were exported, setting a record for the Hawaiian sugar industry. So far a total of 148,900 short tons, or about 22·5 per cent. of the total estimated crop, has been shipped. All plantations are reporting sweeter juices and heavier than normal yields. The weather is unusually favourable to the current crop.

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[1] A contribution by Mr. WYNNE SAYER in *Agr. Journal of India*, XX, 1, pp. 68-69.

[2] One factory in Bihar did not furnish the required figures.

[3] 1 Maund = 82·28 lbs.

Publications Received.

Annual Reports of the Society of Chemical Industry on the Progress of Applied Chemistry. Vol. IX; 1924. (Society of Chemical Industry, Central House, London, E.C. 2). Price: 7s. 6d. to Members of the Society; and 12s. 6d. to Non-members. 1925.

We draw attention to the latest number of these valuable Annual Reports,[1] in which those engaged in our industry will find a good deal of interest, for example, in the sections headed: Sugars, Starches and Gums; Fermentation Industries; Foods; Soils and Fertilizers; Fuel; Plant and Machinery, etc. The value of these reports to chemists and technologists, as a means of keeping up-to-date in subjects bearing on one's speciality can hardly be overestimated.

Sugar Beet Experiments in Louisiana. A. F. Kidder and C. E. Coates. Louisiana Bulletin, No. 192. (Louisiana State University, U.S A.) 1925.

Having in mind the fact that the cane sugar-houses in the State of Louisiana are used at present only 8-12 weeks in the year, and that if the season could be lengthened 8-10 weeks by working up a beet crop, the value of the capital at present invested in this direction would be much appreciated, preliminary experiments on beet cultivation have been conducted by the authors at Baton Rouge. It was found, as the result of four years' tests, that roots containing 13 to 14 per cent. of sucrose with juice of a purity of 80-85° could be produced at the rate of 10-15 tons per acre. These results seem to indicate that sugar beet could probably be grown commercially in this part of the State, but before definitely recommending large-scale operations, the authors require to conduct further experiments.

The Elements of Colloidal Chemistry By Herbert Freundlich; translated by George Barger, F.R.S. Pp. vii + 210. (Methuen & Co., Ltd., London.) 1925. Price. 7s. 6d.

Prof. FREUNDLICH, of the University of Berlin, acting on suggestions which had reached him from various quarters, prepared an abbreviated edition of his "Kapillarchemie," in which mathematical deductions and numerical data were excluded, and the book thus made suitable as an introduction for a wider class of reader. This edition he has called "Grundzuge der Kolloidlehre," and Dr. BARGER was so impressed by this smaller work that he undertook its translation into English. It deals quite fully with the fundamental principles of the subject in a lucid way, and discusses many technical and biological applications. It is one of the best books with which we are acquainted for introducing the student to the wonderful "borderland between physics and chemistry"; and it can be well recommended for this purpose.

Bone Products and Manures. Thomas Lambert. Third Edition; Revised by H. B. Stocks, F.I.C. (Scott Greenwood & Son, London.) 1925. Price: 10s. 6d.

This book is of interest to the sugar technologist by reason of the information it gives on the manufacture of animal charcoal (boneblack) and phosphatic fertilizers, on which subjects it is practical and up-to-date and well illustrated. There is a useful chapter on the production of superphosphates, and another on the analysis of raw and finished materials.

Neuheiten in Zuckerfabriksbetriebe. Ing. Gutherz. (Published privately by the Author, Budapest.) 1925.

Four subjects, concerning recent improvements in the beet sugar industry, are discussed in this lecture, delivered before the Landesverein Ungarischer Zuckerfabrikanten, Budapest, Hungary, on April last, namely, Innovations in Boiler Work; Gredinger's Diffusion System, Pressure Evaporation; and "Carboraffin" (decolorizing carbon) Operation.

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[1] *I S.J.*, 1924, 273, and previously.

A.S.M.E. Boiler Construction Codes. (The American Society of Mechanical Engineers, 29 West 39th Street, New York. U.S.A.) 1924. Price: $2·50.

This book contains the standard rules for the construction of stationary steam boilers, including also rules for inspection.

Starches. Walter A. Nivling. (Barr-Erhardt Press, Inc., of New York City, U.S.A.) 1924.

It deals with the fluidity and viscosity of the starches in relation to the sizing value of their solutions; congealing sizes; sizing compounds; etc.

Agriculture at the Cross Roads: An Analysis of the Position. G. de Belle Ball. (Harrison and Sons, Ltd., London.) 1925. Price: 6d.

Trade Notices.

We have received from the Kilmarnock Engineering Co., Ltd., of Kilmarnock, Scotland, a copy of their latest bulletin. This Company was formed in 1919 to take over the Britannia Works of Messrs. Dick Kerr & Co., Ltd., of Preston. The products of the works at Kilmarnock were well known in Messrs. Dick Kerr & Co.'s time, and the Kilmarnock Engineering Co. have since continued the same class of business. They specialize in all types of trucks for sugar cane plantations, also in railway track, turntables, steam, petrol and electric locomotives. In addition, their works are well equipped for general engineering, and plant for collieries, brickworks and quarries.

The Mirrlees Watson Co., Ltd., of Glasgow, have lately issued a pamphlet (No. S 80) describing and illustrating for intending purchasers the Searby Cane Shredder, of which they are licensees. The principle on which the shredder works, the advantages in using it, the effect on milling capacity and extraction, the size of shredder required and the power needed to work it, etc., are all dealt with. Pamphlet No. S 300, consisting of 36 pages, deals with the same firm's production of Multiple Effect Evaporators. It contains illustrated specifications and tables of sizes, together with the requisite code words for cable ordering. A number of diagrams of arrangement of the evaporators and of the staging on which they are fixed are also offered, for meeting the purchaser's conceivable requirements. Copies of both pamphlets will be sent by the firm to any applicants in the sugar industry.

The Polish Legation in London reports that up to 1st April last exports of raw and white sugar amounted to 103,111 metric tons and 81,147 metric tons respectively. The bulk of this sugar went to the United Kingdom, the Netherlands, Danzig, Germany and the Soviet Union.

Speaking before the Australian Sugar Planters' Association, at Ingham, Queensland lately, Mr. T. B. Munroe, gave a very full account of the advantages, uses, and manufacture of "Celotex" bagasse boarding material, which is now being made in the Commonwealth,[1] a few of his points being as follows: The original factory is now taking the entire output of bagasse from ten of the largest mills in Louisiana, representing 15 per cent. of the total supply of the State. These mills now burn oil or coal, of which (it is here stated) they are given sufficient for their requirements in exchange for their bagasse. At the parent plant the production during the first four years of its existence was 12, 23, 100 and 200 million sq. ft. of boarding respectively. At North Dakota "Celotex" is sold at $ 80 per 1000 sq. ft., in competition with lumber at half this figure. This material has been found to render a house 15-20° Fah. cooler in the summer, and is capable of saving one-third of the fuel necessary to maintain a given temperature in the winter.

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[1] *Austr. Sugar J.*, October, 1924, 16, No. 7, 469-475. See also *I.S.J.*, 1925, 34.

Review of Current Technical Literature.[1]

CONTROL OF CLARIFICATION BY THE DETERMINATION OF THE HYDROGEN-ION CONCENTRATION (USING TEST-PAPERS). (*A*) *H. C. Prinsen Geerligs. Pamphlet published by the author at Amsterdam, 1924 (in Dutch).* (*B*) *F. Tödt. Vereins-Zeitschrift, 1925, 65-82.*

(*A*) This contribution by Dr. GEERLIGS is a clear introduction to this new method of controlling clarification in the sugar factory, cane and beet. He points out that it is now established that the flocculation of the colloidal impurities of juice occurs best at a certain hydrogen-ion concentration (*pH*), and not at a fixed alkalinity, this being the point at which settling is most complete, and at which the scums can most readily be filtered. Acidity or alkalinity determinations indicate only the titratable acidity or alkalinity, whereas the *pH* value indicates the actual, active acidity or alkalinity. In the case of acidity, the difference between the two is illustrated by the behaviour of a refinery liquor and an impure factory product, the latter being able to withstand a much higher titratable acidity than the former before inversion is marked. In both liquids the acidity as determined by titration in the usual way may be identical, yet the rate of inversion is by no means the same. Likewise in the case of alkalinity, the difference is shown by a comparatively pure refinery liquor, and a rather impure factory product, the latter being capable of carrying a higher alkalinity than the former before glucose decomposition becomes apparent. For the determination of the *pH* in the sugar factory, Dr. GEERLIGS gives preference to the use of indicators (rather than the electro-metric method); but he favours their application in the form of test-papers[2] rather than the procedure described by BREWSTER and RAINES,[3] and others He prepared test-papers with the following indicators:—Brom cresol purple, brom thymol blue, corallin, and phenol red, and sent them out to Mr. PEKELHARING, Superintendent at Hormiguero, Cuba, who replied that he had found the first and the last mentioned the most useful, now being able to show the workmen just the limits between which one must work, whereas with litmus, especially with artificial light, this was not always possible. Again, in the best factory, he has found thymol phthalein and naphthyl benzine very good, these papers by a light-blue colour indicating the extent to which one must continue the first carbonatation to fix the optimum point, whereas at this same optimum point it was found in three different factories that the alkalinity varied between 10 and 25 c.c. per 10 c c., the *pH* found electrometrically being always the same, namely, 11·0 at this point. As to the second carbonatation, the indicators here concerned are thymol blue and naphthol phthalein, the "end-point" being a light-blue colour; while the usual sulphitation following carbonatation in the beet factory is controlled by cresol red paper, this corresponding to a *pH* of about 7·4.

(*B*) At the instigation of Prof. Dr. HERZFELD, the author has examined the most practical method of determining the *pH* value for the control of carbonatation in the beet sugar factory, and in general he confirms the results obtained by Dr. GEERLIGS (above). Although the procedure of determining the *pH* value described by American chemists,[4] using buffer solutions, may be quite satisfactory, it appears nevertheless to be somewhat tedious for control work, and anyway is not as direct as the phenolphthalein titration as applied at the present time by the foreman of this station in beet sugar factories. He was therefore attracted by the much simpler *modus operandi* introduced in Holland[5] (see above), in which paper impregnated with a solution of the appropriate indicator is merely dipped into the juice, the alteration of colour denoting the ion concentration. This method, surely simple enough to be used by workmen, was carefully examined by the author in four German factories during last campaign,[6] the colour change at the optimum point of clarification being observed, and the results compared with the ordinary alkalinity titration using phenolphthalein. For the first carbonatation, thymol phthalein paper proved to be the most suitable; phenolphthalein at a alkalinity of 0·05 per cent. CaO was generally colourless; at one of 0·06 (the hitherto accepted optimum) it was light blue; at 0·08 it was medium blue; and at 0·12 it was dark blue. For the second carbonatation, thymol blue was found to be the most suitable. At a phenolphthalein alkalinity of 0·008 it was colourless or yellowish, at one of 0·01 (the usual optimum) a blue coloration was just apparent; at 0·02 it was distinctly blue; and at 0·03 the colour was dark blue. These papers are said to give sharp and definite colour-changes capable of being observed by artificial as well as by daylight In the case of the new beet juice, the alkalinity of the *pH* values was observed to run approximately parallel, but only approximately so, the optimum clarifying point in the first saturation corresponding in two factories to a higher alkalinity than in the other two in which the experiments were made. That the maximum precipitation of impurities and the production of a good filtering scum always under normal conditions took place at the same *pH* was proved, a conclusion which had already been arrived at by the Dutch investigators[1] Since, as is known, this cannot be said of the phenolphthalein alkalinity, the conclusion is that the *pH* values should be applied as the best means of gauging a correctly conducted saturation Not so simple was the determination of the alkalinity of the thick-juices (evaporator syrups), which in the four German factories visited by the author averaged 0·005 to 0·05, the reason for this being that thymolblue paper does not give a clear colour change owing to the viscosity of the product; but cresol red paper shows sharp changes only up to an alkalinity of 0·01. In Germany, however, the alkalinity is held higher, as shown by the average figure cited above, and so far the author has been unable to suggest the use of any suitable indicator for use with the syrup, though this is not a matter of utmost importance, the stage at which control is most urgent being the first and second carbonatation. As to the method of preparing the papers, 1 grm. of the dyestuff is dissolved in 250 c.c. of 70 per cent. alcohol while heating, this being the stock solution, 50 c.c of which are diluted with water to 250 c.c., and used for impregnating the paper (S and S. No. 585, or other similar), which is finally dried in a warm room.[2]

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] See *Tijdschrift*, 1924-5, Nos. 2, 3, and 4. [3] *I.S.J.*, 1923, 90. 1924, 51, 167.

[4] *I.S.J.*, 1924, 51, 167, 480-486; *F. A. S.*, 1924, 298, 496; *La. Planter*, 1922, 69, 167; *J. Ind. Eng. Chem.*, 1921, 1043, and 1922, 941.

[5] *Tijdschrift*, 1924-25, Nos. 2, 3, and 4. [6] *Deut. Zuckerind.*, 1924, 49, 1377.

DETERMINATION OF SUCROSE AND RAFFINOSE IN SUGAR PRODUCTS, USING ENZYMES.

H. S. Paine and R T. Balch. Industrial and Engineering Chemistry, 1925, 17, No. 3, 240-246.

Enzymes are much to be preferred to acid for the hydrolysis of sucrose and raffinose in the analysis of mixtures of sugars in the presence of optically-active impurities. If an extract of top yeast be added to a solution of beet molasses, the sucrose will be hydrolysed by the invertase in it to invert sugar; whilst if to a duplicate sample an extract of bottom yeast be added, the invertase and melibiase in it will hydrolyse the sucrose to invert sugar and the raffinose to dextrose, levulose, and galactose; so that from the differences between the three polarimetric readings obtained, the content in sucrose and in raffinose can be calculated Preparation of the solutions for the action of the enzymes is effected by treatment with basic lead acetate and de-leading with ammonium di-hydrogen phosphate, after which the yeast extracts are added and hydrolysis allowed to proceed either at atmospheric temperature, or more rapidly at 55°C., a correction being made for the polarization of the extracts added. Then the results for the raffinose percentages are calculated by the formula: $R \frac{0{\cdot}352\,(A-B)\,100}{26} = 1{\cdot}354\,(A-B)$, in which A and B are the polarizations after hydrolysis by the top and bottom yeast respectively. P, the direct polarization is represented by $S + 1{\cdot}852\,R$, where S is the sucrose, 1·852 the ratio of the normal weights of sucrose and raffinose (anhydrous), and R is raffinose. But $A = -\,0{\cdot}3213\,S + (0{\cdot}514 \times 1{\cdot}852)\,R = -\,0{\cdot}3213\,S + 0{\cdot}952\,R$. Combining the last two equations, $S = \frac{P - A - 0{\cdot}900\,R}{1{\cdot}3213}$. And substituting the value of R from the first equation given above, one obtains for the value of S: $\frac{P - 2{\cdot}219\,A + 1{\cdot}219\,B}{1{\cdot}3213}$, which formula may be corrected by the addition of factors taking into consideration the concentration. A good number of analyses of beet factory products were made by the invertase and acid methods, and the results of some of these are here summarized :—

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[1] *Loc. cit.* A deviation from this rule was, however, observed, when working with frozen roots for the clarification of which it was necessary to use a lot of lime, but clarification in these circumstances was abnormal.

[2] These papers can be purchased from laboratory supply firms.

		INVERT POLARIZATION			SUCROSE		RAFFINOSE	
MATERIAL.	Direct polarization (P) 20°C. °V	Top yeast extract (A) 20°C. °V	Bottom yeast extract (B) 20°C °V	Acid (I) 20°C °V	Enzyme S_e * %	Acid S_a † %	Enzyme R_e * %	Acid R_a † %
(Colorado Average).	15·15	—4·70	—4·78	—4·67	15·06	14 82	0·10	0·18
(Idaho ,,).	16·60	—5 05	—5·09	—5·15	16·44	16·27	0·06	0 18
(Nebraska ,,).	14·62	—4·42	—4·53	—4·47	14·39	14 26	0·15	0·20
Pulp	2·10	—0·59	—	—	0·29	—	—	—
	1·58	—0·51	—	—	0 23	—	—	—
	1·73	—0 60	—	—	0·25	—	—	—
Steffen waste water. (total)	1·56	—1·22	—1 34	—	0·33	—	0·03	—
	2·09	—1·10	—1 15	—	0·40	—	0·01	—
	1·69	—1·27	—1 31	—	0·37	—	0·01	—
Thick juice	60·35	—19·87	—20·03	—19·64	60·52	60 27	0·22	0 04
	59·89	—18·16	—18·71	—18·88	58·74	59·08	0·75	0·44
	52 90	—16·31	—16·74	—16·74	52·16	52·26	0 58	0·35
White massecuite	80·74	—25 04	—25·96	—24·80	79·37	78·87	1·25	1·01
	85 00	—25·64	—26·58	—26·40	83·21	83·38	1 27	0·87
	80·50	—24 72	—25·48	—25 00	79·27	78 96	1 03	0·83
High wash syrup	60 71	—19 23	—19 99	—19·00	59·99	59 72	1·03	0 53
	67·75	—20 14	—20 75	—20·82	66·27	66 20	0·84	0 84
	66·80	—19·56	—20 66	—20 37	64·66	65·19	1·49	0·87
High green syrup	57·16	—18 02	—18 75	—17·50	56·42	55·76	0·99	0·76
	62 00	—17·54	—18·84	—17·75	59·29	59 02	1·76	1 61
	65·62	—19·06	—20·22	—18·90	63 32	62·60	1 57	1 63
Raw masssecuite	69·94	—21·41	—22 61	—20·30	68·25	66·91	1 62	1·64
	76·40	—21·14	—23 12	—21 00	72·32	71·69	2·68	2 54
	72 00	—21 04	—22·72	—20 70	69 18	68·64	2·27	1·81
Molasses	49 28	—16·19	—16 96	—14 96	48·22	47 93	1·04	0 73
	54·60	—16·41	—18·07	—14·72	52·30	50 89	2·25	2·00
	58·90	—13 90	—17·08	—12·72	52 33	51 13	4·31	4 20
	56·20	—15·18	—17 62	—14·00	51·93	51 01	3·30	2·80
	49·00	—14·72	—15·70	—14·10	47·47	46·73	1 23	1 23

$$^{*}S_e = \frac{(P - 2\ 219\ A + 1\ 219\ B)\ 100}{\text{constant}}$$

In calculating the sucrose content, the constant used was 131·9 when the dilution was 50-55, and 131·7 when it was 50-100. $R_e = 1\ 354\ (A - B)$

$$^{\dagger}S_a = \frac{0\ 5124\ P - I}{0\ 839}\ ;\ R_a = 0\ 54\ (P - S).$$

Beet factory performance frequently decreases as the campaign progresses, due in part to working stored roots containing detrimental non-sugars, but also (it would now appear) to the progressive increase in the polarization of the cossettes, as compared with their true sucrose content, a greater quantity of sucrose being charged into the factory than actually is present, as is illustrated by the following figures: Observed direct polarization, 14·62; sucrose by enzyme method, 14·40; sum of sucrose and raffinose polarizations, 14·68; and direct polarization of optically-active non-sugars substances, 0·06.[1] In California molasses is commonly thought to contain no raffinose, but here are some of the results[2] obtained with this product :—

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[1] In roots these non-sugars were sometimes positive, at other times negative, but in molasses always negative.

[2] Polarizations refer here to sugar scale degrees, normal weight solutions, and 2 dm tube observations.

	1919.		1923.
Observed direct polarization	47·53	..	49·00
Per cent sucrose by Herzfeld-Creydt formula with 0·836 divisor ..	48·71	..	50·10
Per cent. sucrose by Herzfeld-Creydt formula with 0·839 divisor[1] ..	48·54	..	49·92
Per cent. sucrose by Browne and Gamble (Creydt) formula with 0·8396 divisor	48·61	..	50·00
Per cent. sucrose by enzyme method with 131·7 inversion constant..	48·87	..	50·42
Per cent. raffinose by enzyme method	1·02	..	1·28
Per cent. raffinose by all acid formulas..	Nil	..	Nil
Direct sucrose polarization	48·87	.	50·42
Direct raffinose polarization	1·89	..	2·37
Direct sucrose and raffinose polarization	50·76	..	52·79
Non-sugar direct polarization	— 3·23	..	— 3·79
Acid invert polarization due to hydrolysis of sucrose and raffinose..	— 14·94	..	— 15·20
Observed acid invert polarization	— 16·37	..	— 16·78
Non-sugar acid invert polarization	— 1·43	..	— 1·58

Analytical data summarized in this paper have a distinct bearing on the matter of "unaccountable sucrose losses" and the extent to which these are only apparent, i.e., due to errors of polariscopic analysis. It is concluded that the difference between the unaccountable losses by the apparent (acid) and true (enzyme) methods is due primarily to variation in the polarization of the optically-active non-sugar substances, due to the character of the beets, this changing from season to season; and the following are the unaccountable losses based on apparent (acid) and true (enzyme) purities for three periods in U.S. beet factories:—

	COLORADO, 1922	Loss Per cent. on Beets.		Loss Per cent. on Sucrose
I	Apparent purity	0·08	..	0·51
	True purity	0·02	. .	0·11
II	Apparent purity	0·15	....	0·96
	True purity	0·10	....	0·66
III	Apparent purity	0·05	....	0·34
	True purity	0·13	...	0·89
	IDAHO, 1923.			
	Apparent purity	0·40	....	2·39
	True purity	0·31	...	1·90
	NEBRASKA, 1923			
	Apparent purity	0·42	....	2·92
	True purity	0·24	....	1·60

Therefore, in all except the third period of the Colorado data, the unaccountable loss was less by the enzyme true purity method than by the old acid process.

LABORATORY SYNTHESIS OF SUCROSE. *Hans Vogel.* *Zeitsch. Zuckerind. Czecho-Slovakia, 1925, 49, No. 20, 152-153.*

Hypotheses elaborated by BAYER and others state that the synthesis of carbohydrates by the plant results from the reduction of carbon dioxide to carbon monoxide; the union of carbon monoxide and hydrogen (from water) to give formaldehyde; the polymerization of this latter to simple hexoses; and the condensation of these to higher members of the series, the principal factor in this reaction being chlorophyll, which is believed in some way to supply the necessary energy to the endothermic reaction by acting as a light-filter. Since during the production of carbohydrate by the plant, only a little formaldehyde can be detected, the author of this paper came to the view that the formaldehyde must be present in the nascent state, this condition allowing of its immediate conversion to carbohydrate. Acting on this idea, he constructed an apparatus by means of which carbon monoxide and hydrogen were caused to unite over zinc dust in the absence of air, so as to form formaldehyde *in status nascendi*. He claims that on washing the zinc dust after the completion of the reaction he obtained a solution of sugars, which included dextrose and levulose, the presence of which was shown by the reduction of Fehling's solution and the reaction with sodium hydroxide and picric acid. Later, during the summer months, he repeated the experiments in the present of sunlight, and succeeded (he believes) in obtaining even better results, since in the solution obtained on extracting the zinc dust he was able to find sucrose, by means of the α-naphthol and sulphuric acid reaction [1]

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[1] As directed in "Methods of Analysis," The Great Western Sugar Company.

HYDRATED LIME, ITS ADVANTAGES COMPARED WITH ORDINARY CAUSTIC LIME IN LUMPS.

Alfred B. Searle. *The Industrial Chemist, 1925, 1, No. 1, 38-41.*

Hydrated lime, $Ca(OH)_2$, in the form of a fine powder, is being recommended in certain quarters for use in the cane sugar factory, in place of ordinary caustic lime, CaO, in lumps, and the remarks of this writer on the subject are as follows: "It is customary to buy 'lump' lime from the quarries, slake it more or less crudely, and then use the resulting milk Lump lime is an inconvenient substance in many ways · It does not pack well in bags; the lumps are awkward to handle; the material is caustic and may easily cause serious burns; it heats rapidly when wetted and so may cause damage; and it is by no means a stable compound. Added to these objections there is always great uncertainty as to its purity, and lumps of unaltered stone or of stone which has only a superficial coating of lime are quite common and cause much trouble. Occasionally they damage the slaking machine or still or other appliance to which they are admitted. Hydrated lime, on the contrary, when properly made, is in the form of a fine powder, quite free from caustic action, which does not become heated when wetted, and can be kept in bags of paper or in any other convenient material; it does not readily deteriorate on keeping, though it is liable to become sticky when accidentally wetted. Hydrated lime is made by slaking lumps or small pieces of quicklime with exactly the quantity of water necessary to combine with the lime [2] As no excess of water is present, as in ordinary slaked lime, and as no unslaked, caustic lime or imperfectly burned stone is present, hydrated lime takes its place along with other chemicals as a substance of reasonable commercial purity supplied in a convenient form From the point of view of convenience in storage and in use, of purity, accuracy of dosage or general suitability, it is incomparably superior to either lump or ground lime, and yet it can be produced at a cost which enables it to be sold at the same price as lump lime and several shillings per ton cheaper than ground lime. The idea of grinding quicklime, which is afterwards to be used in the presence of water, is indeed foolish, because it is quite unnecessary; hydrating the lime will produce an even finer and purer powder at a far less cost because, in a properly equipped hydrating plant, the sand and other impurities in the lime are separated from the hydrate "

Lastly, however, be it noted, this writer concludes with the following remark · "So far as the sale of hydrated lime is concerned, it is a profitable side line to the ordinary lime burner, as the weight is increased 30 per cent [3] in consequence of the combined water, and, in addition, the hydrated lime sells at about 7s. 6d. per ton more than lump lime."

QUESTION OF PROFIT OR LOSS IN CANE SUGAR CULTIVATION AND MANUFACTURE

Carlos L. Locsin. *Sugar News, 1925, 5, 463-465.*

Assuming certain yields (50 to 120 piculs per hectare), and varying expenses (viz., in respect of preparation and cultivation, fertilizer, milling, and depreciation), a table is given by means of which the total cost per picul of sugar produced may be calculated. Another table gives figures from which the gross and nett profit of the lessee or the proprietor of an estate can calculate his gains with different costs for a 12 per cent. lease. Suggestions are made for making out similar tables for other types of lease and other sugar prices. J. P O.

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[1] This chemist's means of proving the presence of dextrose and levulose, and sucrose, are hardly convincing. Prof. E. E C. BALY has produced much more definite evidence of having succeeded in synthesizing formaldehyde and substances resembling hexose sugars by the action of ultra-violet rays on a solution of carbon dioxide. His experiments appeared to show that it was necessary to use rays of a certain wave-length, and that chlorophyll absorbs the visible rays and radiates it at frequencies capable of effecting the reaction.—Ed., *I.S.J.*

[2] Reaction taking place is · $CaO + H_2O = Ca(OH)_2$

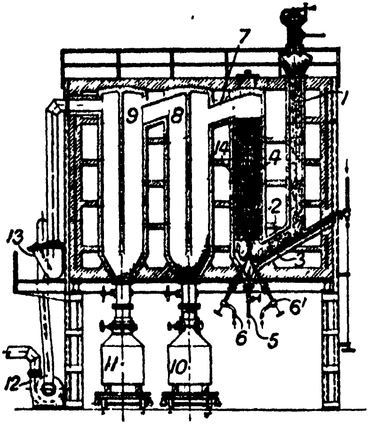
[3] That is, while the weight of the CaO is 56, that of the hydrated material is 74, an increase to be paid for in freight.—ED. *I.S.J.*

Review of Recent Patents.[1]

UNITED KINDGOM.

PREPARATION OF ACTIVE (DECOLORIZING) CARBON. *H. E. Potts (Naamlooze Venootschap Algemeene Norit Maatschappij,* of 2, Den Texstraat, Amsterdam, Holland). *228,582.* August 9th, 1923.

Active carbon is prepared by introducing finely divided carbonaceous material into a hot chamber, where it is maintained in suspension by gas and is activated by gas, and finally drawing off the activated portion by virtue of its lower apparent specific gravity. The raw or predistilled material, such as fruit pips, wood, peat, lignite, or other materials of vegetable, animal, or mineral origin, may be fed to a container *1* leading to a down passage *2* provided with an injector *3*, and upon entering the activation chamber *4* it encounters a number of jets of gas, of which *6*, *6*¹ may supply combustible gas mixture or fluid fuel and *5* steam. The blast of steam is so regulated as to keep the material in suspension for a sufficient time for it to become activated, and finally the gases and activated carbon are drawn off by means of an exhauster *12* through a conduit *7*, settling chambers *8*, *9*, and dust collector *13*, while the unactivated material remains behind. The activated material deposits in the chambers *8*, *9* and is drawn off into containers *10*, *11*. To obtain better heat conduction within the activating chamber, the latter may be provided with heat radiating surfaces, such as transversely disposed and staggered baffle rods *14* of heat refractory material, namely silica, fireclay, or magnesia, though the provision of such surfaces does not form part of the invention Instead of or in addition to internal heating, burning gases, benzene, crude oil, petroleum, etc., or other form of internal or external heating may be employed, such as by the provision of electrically heated rods or internally heated pipes. The nature of the raw material, and the temperature, quantity, quality, and velocity of the gases may be adjusted so as to obtain products of known activity or novel products of enhanced activity, and the specification sets out a number of the properties of these novel products. An example shows the production of a novel carbon by treating finely divided pinewood charcoal in a retort to which crude oil, air, and steam are fed, while another example shows the production of a known carbon by varying the temperature and size and rate of charging of the charcoal. The new products are especially useful for gas absorption, as catalysts, and for the purification and sterilization of sugar juices, water, oils, such as linseed and soya bean oils, fats, and other liquids. Specifications 198,328 and 206,862 are referred to. The provisional specifications state in addition that suitable activating gases are carbon dioxide, producer gas, water gas, Mond gas, air, chlorine, sulphur dioxide, volatile chlorides, ammonia, etc , and that irregular lumps of quartz or the like may be placed in the activating chamber.



EVAPORATOR. *A. Blair and Blair, Campbell & McLean, Ltd.,* of Govan, Glasgow. *228,691.* January 12th, 1924.

In apparatus comprising a tubular preheater, a vertical calandria, and an exhausted evaporating chamber through which the liquid to be evaporated is circulated by a pump, the calandria is provided with at least three sets of tubes in series, each set containing at least two tubes in parallel. In the form shown there are five sets. Means are also provided for removing the concentrated liquid from the chamber without breaking the vacuum therein. In the form shown the liquid escapes through a long fall tube, about which is disposed a coiled tube through which steam can be passed to prevent the liquid from setting. Alternatively the concentrated liquid may be removed by a worm rotating in a casing.

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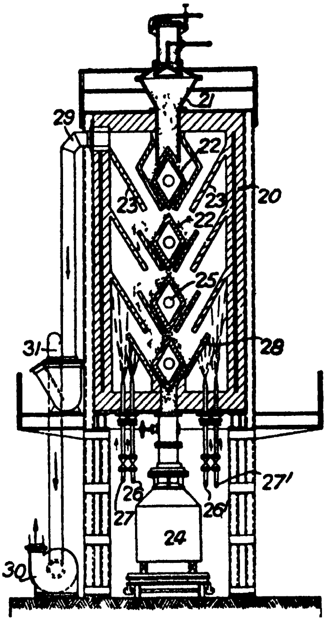
[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States*· Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

PREPARATION OF ACTIVE (DECOLORIZING) CARBON. *H. E. Potts* (*Naamlooze Venootschap Algemeene Norit Maatschappij*, of 2, Den Texstraat, Amsterdam, Holland). *228,812.* August 9th, 1923.

Active carbon is produced by subjecting carbonaceous material, for example wood or fruit pips, to the action of activating gases while freely moving in close proximity to heat radiating surfaces supplementary to the ordinary walls of the retort. The use of rotary retorts is excluded. The heat-radiating surfaces may consist of baffle rods, which, the provisional specifications state, may be transversely disposed in staggered horizontal layers and may be composed of silica, fireclay or magnesia heated to the activation temperature, or may be hollow and internally heated. In the apparatus illustrated the heat-radiating surfaces consist of a number of superimposed hollow rhomboids *22* heated by flue pipes *25* and disposed within an activating chamber *20* provided with inlets *26*, *26*^{1} for activating gas and inlets *27*, *27*^{1} for the combustible gas mixture for internal heating. The raw material fed from a hopper *21* is forced to move in thin layers past the rhomboids by the provision of baffles *23*, *28* and is finally discharged into the chamber *24*. The gases are drawn off by an exhauster *31* through a conduit *29* and dust collector *30*. The nature of the raw material, which should be finely divided, the temperature and the quantity, quality and velocity of the gases may be adjusted so as to yield novel products of very high activity, which according to the provisional specifications may be used for catalytic reactions, gas absorption, and for the purification and sterilization of sugar juices, water, oils such as linseed and soya bean oils, fats and other liquids and may be easily regenerated by burning or treatment with acids, alkalies, etc. In the provisional specifications peat and pre-distilled material such as charcoal and peat coke are described as suitable initial materials, steam, carbon dioxide, air, producer gas, water gas, Mond gas, chlorine, sulphur dioxide, volatile chlorides, ammonia, etc., as suitable activating gases and lumps of quartz and the like as heat radiating surfaces. Specification 228,582 is referred to.



BOILING AND CURING IN WHITE (BEET) SUGAR PRODUCTION. *K. Philipp*, of Magdeburg, Germany. *225,221.* November 20th, 1924; Convention date, November 24th, 1923.

In making white sugar from beet syrup, or in producing white or refined sugar from solutions of raw sugar by a series of crystallizations and centrifugings, crystals from a later stage are added to a massecuite which, after centrifuging, is cleared by diluted mother-liquor derived from an earlier stage. Examples of the process are given and it can be combined with other known modes of refining.

ALCOHOL MOTOR FUELS. (1) ***Badische Anilin & Soda Fabrik***, of Ludwigshafen-on-Rhein, Germany. *226,731.* May 23rd, 1924. (2) ***Benj. H. Morgan***, of Westminster, London. *225,685.* August 15th, 1924.

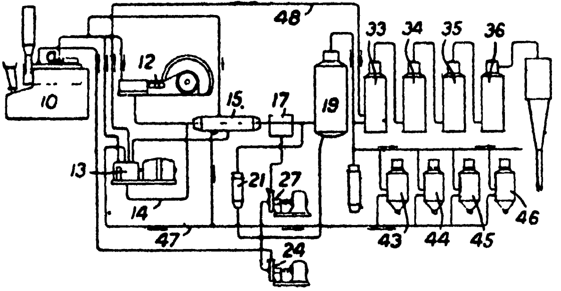
(1) Iron carbonyl is added to liquid fuels. In an example, 0·1 to 1·0 per cent. of carbonyl is dissolved in alcohol, in gasoline, or other hydrocarbon, or in a mixture, to prevent "knocking." The carbonyl may be produced simultaneously with the fuel, e.g., by supplementing the process described in Specification 20488/13 by passing the reaction gases containing carbon monoxide over finely divided iron after they have been in contact with the catalyst

(2) Motor spirit consists of about 50 lbs. of petrol and 50 lbs. of a mixture of two 1 lb. of alcohol with one 2 lbs. of ether. Up to 5 lbs. of castor oil may be added to assist lubrication and prevent corrosion from acid formed by combustion of the alcohol.

'EAM SUPPLY AND POWER ARRANGEMENTS IN THE CANE SUGAR FACTORY. ***W. A. Gilchrist***, of Chicago, U.S.A. *229,649.* February 2nd, 1924; convention date, February 19th, 1924, not yet accepted.

Relates to steam-supply and power arrangements in factories (such as those in which juices are evaporated). Steam generated under high pressure is used to operate prime movers from which steam is exhausted under a higher pressure than usual; whilst the exhaust steam is used to evaporate a liquid and generate vapours under a lower pressure which are used as heating agent to effect a further evaporation. As applied for evaporating sugar juices, steam from a boiler *10* heated preferably by a furnace which burns bagasse, is supplied to prime movers such as a reciprocating engine *12* and a steam turbine *13*; whilst the exhaust steam passes through pipes *14* to a mixer *15* in which it is mixed with steam direct from the boiler *10* to dry it, then through a humidifier *17*, in which its temperature may be reduced, to a preliminary evaporator *19* in which juices, after clarification and after passage through a preheater *21*, are boiled. Steam thus generated is used as heating-agent in a multiple-effect evaporating apparatus, *33-36*, and in the pans *43-46*. Steam passing direct from the prime movers through pipes *47*, *48* may also be used for this purpose. Condensed steam from the heater of evaporator *19* is in part passed back to the boiler by a pump *24* and in part circulated through the humidifier *17* by a pump *27*.

FIG. 1



PREPARATION OF MOLASSES FOR ITS FERMENTATION. ***A. P. C. Jorgensen and N. L. C. H. Kilhauge***, of Copenhagen, Denmark. *228,734.* March 24th, 1924.

Molasses for the cultivation of yeast is boiled with sulphuric acid and superphosphate, powdered slaked lime added and the mixture allowed to stand. The clear liquid is then decanted from the precipitate and inoculated with lactic acid bacteria. Suitable bacteria are obtained by isolating them in the ordinary way from raw sugar molasses and cultivating them in a mixture of molasses and extract of malt, in which the malt extract, originally half the mixture, is gradually reduced till at the end of three weeks the medium consists of molasses only. When the lactic acid reaches the equivalent of 5 c.c. of normal soda per 100 c.c., the molasses solution is sterilized and filtered. The precipitate obtained in clarifying the molasses is stirred with water, which is then passed to an air fermentation vat and seeded with 15-30 per cent. of yeast, and the acidified molasses gradually added, with the addition of ordinary phosphatic and nitrogenous nutrients, and, if desired, cereal wort.

UNITED STATES.

Automatic Density Control for Dorr "Thickeners." *John V. N. Dorr* (Assignor to the *The Dorr Company,* of New York, N.Y., U.S.A.). *1,518,136.* December 9th, 1924.

This invention relates to improved means for controlling the operation of decanting vessels or "thickeners" which are now widely used in industrial and metallurgical processes for the purpose of separating a greater or less proportion of the liquid from large quantities of liquids having finely divided solids in suspension. In such decanting vessels or thickeners, the solids are caused to settle in tanks and the clear, or relatively clear, liquid above is made to overflow from the settling tank, the settled solids being drawn or pumped through a suitable discharge orifice at the bottom of the vessel. Apparatus of this character is shown, for example, in United States Patent No. 867,958 of October 15th, 1907. It is of great importance to provide for such apparatus an automatically-acting control which can be closely regulated so that the overflow or underflow or both will be of uniform character, notwithstanding unavoidable variations in the nature of the material to be treated or its rate of feed to the thickener. In fact, in many applications, the overall efficiency of the apparatus is directly dependent upon the closeness of the control. In another patent, No. 1,140,131 of May 18th, 1915, were disclosed means for automatically regulating the discharge of the underflowing material or the inflow of the material to be thickened, for the purpose of maintaining constant conditions in the underflow or the overflow, or in both, and the present invention is more particularly concerned with the improvement of the method and apparatus for maintaining these conditions constant, and especially for maintaining constant the density of the underflow. In that patent a hydrometer or float is inserted in the settling vessel, and through suitable electrical devices controls the opening and closing of a valve in either the discharge conduit or the supply conduit of the vessel. Control is thus effected in response to the changes in density of the material under treatment. Apparatus constructed in accordance with this invention has proved successful and operative in commercial practice. However, the apparatus constructed in accordance with the present patent is more efficient, and gives more reliable and convenient regulation because the hydrometer is dispensed with and there is, therefore, no opportunity for its action to be influenced by the motion of the liquid in the settling vessel, and thus affect the accuracy of the apparatus. Nor is there any opportunity for material to deposit on the hydrometer from this liquid, which also affects the accuracy of the apparatus. According to the present invention the density control, which may be in response to the varying density of either the underflow or the overflow, although the underflow is preferred, is effected by passing the underflow or the overflow, as the case may be, from the settling vessel through a section of conduit which is flexibly inserted in a pipe line for the discharge of the settling vessel and is so arranged that this section is continually weighed. If the density of the material passing through this section varies, the weight of the section will vary, and its balance or equilibrium will be disturbed. Any such disturbance of the balance of the section is caused to control or regulate the rate of discharge or the rate of supply. By the employment of a conduit section, the varying weight and consequently varying motion of which is caused to regulate the rate of discharge or the rate of supply, the opportunity for evaporation and consequent deposit of solids on the hydrometer is eliminated since the interior surfaces of the conduit section are subjected only to a rapid flow of the liquid under conditions where evaporation does not take place, as contrasted with the hydrometer which is subject to the deposits caused by the evaporation of the liquid in an open vessel.

Process of Refining, using Active (Decolorizing) Carbon. *Donald Grant* (assignor to *Klarit, Ltd.,* of Litherland, near Liverpool). *1,530,823.* March 24th, 1925.

Claim 2 :—The process of refining impure sugar, which consists in mixing the solid, impure sugar with activated carbon in powdered form, dissolving the sugar in water, and separating the solution from the carbon and impurities.

DEXTROSE MANUFACTURE.[1] *William B. Newkirk* (assignor to *International Patents Development Co.*, of Delaware, U.S.A.). (*A*) *1,508,569.* September 16th, 1924. (*B*) *1,521,829.* (*C*) *1,521,830.* January 6th, 1925.

(*A*) Starch-converted dextrose having a purity of 99 per cent. or greater and consisting of a mass of separate, unitary crystals of dextrose hydrate of normal crystalline form for this type substantially unmixed with deformed crystals of the needle-like or flake-like kind. (*B*) Improvements in the method of making dextrose from a starch-converted dextrose solution, which consists in maintaining in substantially uniform dispersion through the solution and from beginning to end of the crystallizing operation, solid phase dextrose of substantially single type crystal and normal crystallized form in such relatively large amount that the quantity of the solid phase is a significant factor in controlling crystallization. (*C*) Starch-converted dextrose consisting of a mass of separate, unitary, anhydrous dextrose crystals of normal crystalline form for the anhydride, substantially unmixed with deformed crystals of the needle-like or flake-like kind.

HEATING TUBE SYSTEM FOR A VACUUM PAN, ETC. *Horace F. Ruggles*, of New York, U.S.A. *1,520,368.* December 23rd, 1924.

Referring to the drawings, it is seen that the heating system in its simplest form consists of a plurality of annular tube units, basketed one into the other, each unit comprising a circular top coil *28*, arranged concentrically with, and, with appropriate clearance, fitting into the shell of the pan, and a concentric circular bottom coil *29* of much smaller diameter, and positioned a considerable distance below the top coil. These two coils are communicating with each other through a series of downwardly inclined pipes *30*, straight or, as shown afterwards, curved in the same direction. This combination forms a trellis-like pipe basket of inverted conical shape, and the different units which preferably are of the same pattern, are superimposed over each other at equal vertical distances, with the exception of the lower ones, that can advantageously be spaced further apart in the vertical direction, as shown at *M*, *N*, and *O*. Each of the pipe units must be provided with at least one inlet and one outlet pipe leading to and from the outside of the shell. In Fig. 1 only one stream inlet *31*, for each unit is shown, jointed into the annular top coil at a sharp angle or with a tangent curve. All the inlets are arranged in vertical alignment and on the outside of the shell they unite in a manifold *32* of sufficient diameter to supply steam to all the units. This manifold is of the common form. The entrance for the steam is shown at *32a*. Numeral *32b* represents a regulating and shutting-off valve, and the top end is covered by a blind flange *32c*. The manifold and the outside steam fittings are made of cast-iron. The steam outlet pipes *35* are connected to the circular bottom coils *29*, one to each unit, and are equally spaced around the inner circumference. This makes them of different lengths, each commencing a step lower than the preceding one, but all descending vertically to a common level where they are bent

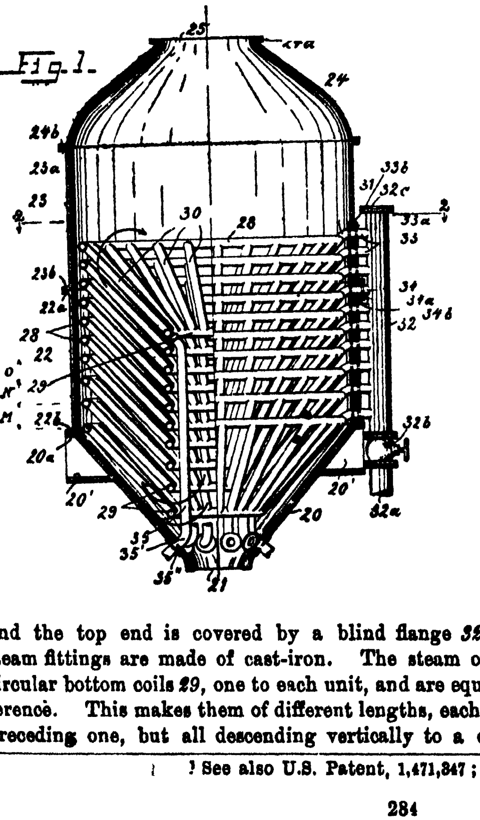


Fig. 1.

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[1] See also U.S. Patent, 1,471,347; *I.S.J.*, 1924, 285.

outwardly, as shown at *35'* and flanged to the conical bottom *20* of the shell, provided with a series of corresponding outlets *35'*. On the outside these outlets are connected to a system of tailpipes, separate steam traps and valves, not specified in the drawing, but self-evident to those skilled in the art. Regarding the different advantages the pipe system, so far as described, offers, it is apparent in the first place, that all pipe units drain easily toward the bottom outlet, so that they get rid of any condensation water without delay. It is also obvious that the path of the steam is in opposite direction to the path of the rising liquor, and that the temperature of the entering steam is highest towards the top and amongst the thinnest liquor, also that the temperature decreases from the outside of the shell toward the middle. The novel arrangement shown follows and favours the formation and circulation of natural vortices. Aside from shortening the time it takes to bring the liquor to the point of ebullition, this condition and the avoidance of too many obstacles to the rising steam bubbles, also lessens the tendency to foam or prime and consequent entrainment, that is, in the case of sugar boiling; the transport of molasses particles by the vapour, and the ensuing contamination of the condensed water, making it unfit for further use. One of the greatest advantages, however, resulting from the peculiar construction, is the enormous increase of heating surface and output, without a corresponding decrease of capacity. To wit: A good average of heating surface for a 12 ft. diam. pan (coil pan of any standard make) is 850 sq. ft., whereas a 12 ft. pan, equipped with the novel pipe system, would represent 1800 sq ft., that is, more than double that amount, or a heating surface of 1·83 sq ft. per cub ft. of content.

FILTER-PRESS FOR USE IN DECOLORIZING CARBON TREATMENT *Charles D. Burchenal*, of New York, N.Y., U.S.A. *1,488,862*. April 1st, 1924 (Nine figures; and 19 claims.)

This invention comprises a novel filter-press of the plate-and-frame type capacitated to permit the material or fluid which is being filtered to be circulated continuously through the filter. Filtered liquid and concentrated fluid or semi-fluid may be discharged separately from each other, or the solid matter after separation may be retained and formed into a dry cake within the frames, as desired, or concentrated, previously-filtered fluid may be returned to the cells to be formed into a dry cake. It further comprises a process in which a filter of the kind described may be utilized, for the treatment of liquids by solid materials in powdered or other finely divided form, such as in decolorizing and continuously delivering the liquid free from solid particles, and later discharging the solid powdered material, when spent or exhausted, in the form of a dry cake. Solution being filtered is drawn from a tank into the frames of the press. The filtrate passes through the media on each side of each frame and is drawn off through headers to which respectively are connected pipes leading to the reservoirs. If it is desired to retain within the frames all of the sludge that is separated from the filtrate, a valve is closed; but if it is desired to allow the sludge to pass back to the tank, the same valve is opened to some extent, thereby permitting the sludge to pass out of the frames through a header back to the reservoir. By proper adjustment of the valve, the pressure within the frame may be controlled to a certain extent, and the speed of filtration may thus be regulated. If desired, after the filter has been operating for some time with the valve open and the sludge passing back to the tank, the valve may be closed and the cake may be built up within the frames on the filter media. Lastly, this cake may be removed in the usual manner by dissembling the plates and frames.

ALCOHOL MOTOR FUELS. *(A) D. T. Day*. *1,513,746*. November 4th, 1924. *(B) A. A. Backhaus* (assignor to *U.S. Industrial Alcohol Co.)*. *1,516,907*. November 25th, 1921; renewed September 13th, 1924.

(A) Mineral oil containing paraffin wax and also resin is treated with hot alcohol to obtain a liquid suitable as motor fuel. *(B)* This fuel consists of a petroleum distillate and absolute methyl alcohol.

SYRUP PAN. *Eugene A. Lester*, of Punta Gordo, British Honduras. *1,520,582*. December 23rd, 1924. SUGAR CANE STRIPPER. *Cleveland A. Lambert*, of Red Level, Alabama, U.S.A. *1,495,086*. May 20th, 1924.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1925. Tons.	1924. Tons.
Total Receipts, January 1st to April 29th	1,302,104	1,203,952
Deliveries ,, ,,	1,222,955	1,160,320
Meltings by Refiners ,, ,,	1,151,530	1,054,260
Exports of Refined ,, ,,	40,000	42,000
Importers' Stocks, April 29th	79,149	44,426
Total Stocks, April 29th	172,531	170,275
	1924.	1923
Total Consumption for twelve months	4,854,479	4,780,684

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1922-1923, 1923-1924, AND 1924-1925.

(Tons of 2,240 lbs.)	1922-23 Tons.	1923-24 Tons	1924-25 Tons
Exports	1,469,037	1,455,575	1,563,873
Stocks	653,692	660,388	802,936
	2,122,729	2,115,963	2,366,809
Local Consumption	30,000	30,000	45,000
Receipts at Port to March 31st	2,152,729	2,145,963	2,411,809

Havana, March 31st, 1925 J. Guma.—L. Mejer.

Beet Crops of Europe.

(*Willett & Gray's Estimates to April 30th, 1925.*)

	Harvesting Period	1924-25. Tons	1923 24. Tons	1922-23 Tons
Germany	Sept.-Jan.	1,600,000	1,146,891	1,455,078
Czecho-Slovakia	Sept.-Jan.	1,460,000	1,001,049	734,856
Austria	Sept.-Jan.	74,000	47,321	24,468
Hungary	Sept.-Jan.	200,000	122,588	81,603
France	Sept.-Jan.	830,000	490,850	492,705
Belgium	Sept.-Jan.	400,000	300,121	268,928
Holland	Sept.-Jan.	335,000	231,923	255,592
Russia (Ukraine, etc.)	Sept.-Jan.	450,000	366,742	193,400
Poland	Sept.-Jan.	495,000	389,995	301,890
Sweden	Sept.-Jan.	135,000	153,890	71,790
Denmark	Sept.-Jan.	136,000	102,358	88,382
Italy	Sept.-Jan.	425,000	351,102	297,280
Spain	Sept.-Jan.	260,000	185,063	160,035
Switzerland	Sept.-Jan.	6,000	5,500	6,033
Bulgaria	Sept.-Jan.	40,000	26,566	16,250
Roumania	Sept.-Jan.	90,000	71,826	49,872
England	Sept.-Jan.	21,700	13,280	7,011
Other Countries	Sept.-Jan.	217,300	50,696	69,152
Total in Europe		7,175,000	5,057,761	4,674,325

Sugar Crops of the World.

(Willett & Gray's Estimates to April 30th, 1925.)

	Harvesting Period.	1924-25. Tons.	1923-24. Tons.	1922-23. Tons
United States—Louisiana	Oct.-Jan.	93,953	144,664	263,478
Texas	,, ,,	450	2,500	2,875
Porto Rico	Jan.-June	464,000	399,975	338,456
Hawaiian Islands	Nov.-July	590,000	626,279	479,463
West Indies—Virgin Islands	Jan.-June	7,200	2,332	1,739
Cuba	Dec.-June	4,925,000	4,066,642	3,602,910
British West Indies—Trinidad	Jan -June	50,000	52,045	41,619
Barbados	,, ,,	53,000	44,109	52,715
Jamaica	,, ,,	42,600	33,431	33,029
Antigua	Feb.-July	14,500	7,860	12,642
St. Kitts	Feb.-Aug.	16,000	10,196	10,735
Other British West Indies	Jan.-June	9,000	4,488	5,292
French West Indies—Martinique	Jan.-July	23,000	17,110	19,700
Guadeloupe	,, ,,	34,000	27,548	25,043
San Domingo	Jan.-June	240,000	229,373	184,171
Haiti	Dec -June	7,000	5,800	10,967
Mexico	,, ,,	165,000	166,932	149,338
Central America—Guatemala	Jan.-June	24,000	20,850	24,445
Other Central America	,, ,,	65,000	55,281	50,336
South America—				
Demerara	Oct.-Dec. and May-June	100,000	95,494	101,128
Surinam	Oct. Jan.	10,200	10,682	11,719
Venezuela	Oct.-June	19,000	17,488	16,840
Ecuador	Oct.-Feb.	18,700	13,662	14,220
Peru	Jan.-Dec.	300,000	326,352	320,445
Argentina	May-Nov.	240,000	249,162	209,718
Brazil	Oct.-Feb	500,000	425,000	595,723
Total in America		8,011,603	7,055,255	6,578,746
Asia—British India	Dec.-May	2,537,000	3,317,000	3,044,000
Java (1925-26: 1,980,000)	May-Nov.	1,977,490	1,771,772	1,746,875
Formosa and Japan	Nov.-June	460,000	448,736	405,800
Philippine Islands	,, ,,	462,000	372,332	263,437
Total in Asia		5,436,490	5,909,840	5,460,112
Australia	June-Nov.	435,680	281,859	306,678
Fiji Islands	,, ,,	70,000	58,000	37,154
Total in Australia and Polynesia		505,680	339,859	343,832
Africa—Egypt	Jan.-June	110,000	88,382	94,554
Mauritius	Aug.-Jan	221,000	201,550	231,190
Réunion	,, ,,	43,500	44,132	42,872
Natal	May-Oct.	144,196	181,571	142,287
Mozambique	,, ,,	55,000	56,400	45,950
Total in Africa		573,696	572,035	556,853
Europe—Spain	Dec.-June	10,629	7,871	13,918
Total cane sugar crops		14,538,098	13,884,860	12,953,461
Europe—Beet sugar crops		7,175,000	5,057,761	4,574,325
United States—Beet sugar crop	July-Jan.	974,185	787,217	615,936
Canada—Beet sugar crop	Oct -Dec.	36,200	16,500	12,400
Total beet sugar crops		8,185,385	5,861,478	5,202,661
Grand total Cane and Beet Sugar	Tons	**22,723,483**	**19,746,338**	**18,156,122**
Estimated increase in the world's production	,,	2,977,145	1,590,216	541,067

United Kingdom Monthly Sugar Report.

Our last report was dated the 9th April, 1925.

The market has been flat throughout the period under review and prices for all descriptions are 1s. 6d. to 2s. per cwt. lower. This decline has chiefly been brought about by the pressure of Cubans.

Business on the terminal market has been on a much bigger scale and a very large volume of orders has been transacted. The April account was very small and tenders only amounted to 200 tons. On the other hand, the May account proved to be a large one and, in spite of very heavy liquidations, over 10,000 tons have already been tendered and there still appears to be considerable interest shown in this month. May fell from 17s. 9¾d. to 17s. then recovered to 17s. 4½d. only again to recede to 15s. 11¼d. It is interesting to note that this is the first occasion the London Terminal Market has been under 16s. since its inception in 1921, the previous lowest in any month being 16s. 4½d. in 1922. Small transactions took place in June and July at declining prices but an enormous business was put through in August, sales being caused by hedging operations against American and Canadian and Continental Granulated. This month sold from 18s. to 17s. 4½d to 17s. 9d. to 16s. 3¾d., finally recovering to 16s. 7½d. September was also sold at practically the same prices as August. New crop continues to be active, all months were dealt in heavily including the month of March, 1926. October/December both together and separately sold from 18s. to 17s. 5¼d. to 17s. 9d. to 16s. 4½d. to 16s. 7½d., November sold down from 17s. 2¼d. to 16s. 6d. to 16s. 9d. The latest prices are May 17s. 3¾d., August 17s. 8¼d., December 17s. 8¼d, March 17s. 9d.

Trading in actual sugars was not very brisk at the outset but latterly there has been a much better demand at the lower level and the trade are more interested. Fine Granulated on the spot declined from 31s. 5¼d. to 29s. 9d. duty paid, less 1½ per cent. Canadian and American Granulated have been pressing for sale and declined from 18s. 6d. to 17s. c i.f., but recovered to 17s. 6d. at the close. White Javas have been very quiet and prices have fallen about 1s. per cwt. with only isolated sales made here and there. Czecho and Fine Dutch Granulated have been sold from 18s. 6d. down to 16s. 6d. f.o b. for ready and May/August shipment, but at the close the price is 16s. 9d. to 16s. 10½d. Offers of Belgian sugars have been sparse as their prices are above parity, to-day's value being 16s. 9d. Russia has again been in the market for Refined and has made further purchases.

In the Budget of April 28th, the Chancellor of the Exchequer increased the preference on Colonial Sugar from 1s. 11d. to 4s. 3d. per cwt. as formerly.

The continued increase in Cuban stocks caused a certain amount of pressure of Cuban raws. The British Refiners bought all the way down from 13s. 7½d. to 12s. 3d. c.i.f U.K. The latest price is 12s. 6d. The Continent also purchased several cargoes at prices ranging from 13s. 6d. to 12s. 3d. The feature of the raw market this month was the purchase by our Refiners of 160,000 tons of Queensland Raws 96 per cent. for June/November shipment, the price to be based on the price ruling for raw sugar on the date of arrival of each shipment; Canada also purchased 20,000 tons on similar conditions.

The U.K. Refiners made a series of reductions in their prices. On 14th April by 6d. per cwt., on 16th April by 3d. per cwt., May 1st 6d. per cwt. and 9d. for forward, on May 6th 6d. per cwt., but on May 7th they were again advanced by 6d. per cwt. The latest prices are No. 1 Cubes 35s. 3d , London Granulated 31s. 1½d.

A large business was done in America in Cubans, Porto Ricos and Philippines down to 2¼ cents c.i.f. New York at which price there has been considerable business done, but there appears to be a certain amount of resistance on the part of sellers.

The Cuban crop is making excellent progress and the receipts at the ports to date are 500,000 tons more than at this time last year, and only about ten Centrals have stopped working. The production at the end of April is reported to be 4,300,000 tons. GUMA has increased his estimate to 4,925,000 tons.

With regard to the European Sowings the latest estimate from Mr. F. O. LICHT gives a minus of 2·4 per cent. against his previous estimate of 5 per cent. less. It is understood, however, that the sowings in Czecho-Slovakia are to be increased by 1·4 per cent. instead of decreased. In certain quarters it is reported that the sowings taken as a whole will be much the same as last year.

21, Mincing Lane,
London, E.C. 3.
May 11th, 1925.

ARTHUR B. HODGE,
Sugar Merchants and Brokers

THE

INTERNATIONAL

SUGAR JOURNAL.

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No. 318. JUNE, 1925. Vol. XXVII.

Notes and Comments.

Cuba's Sugar Production nearing its Maximum ?

In April General Gerado Machado, president-elect of Cuba, paid a visit to the United States, amongst other purposes with a view to urging increased reciprocal trading facilities between the United States and Cuba. In a speech he made at a banquet given to him by New York citizens, the General referred to the by no means small part Cuba had played in the Great War by extending her production of sugar and supplying the Allies with this food, at prices which were none too remunerative in his opinion if the costs of production at the time were considered. All the energies of the Cuban people during that period were directed to increasing the output of sugar for food, and molasses for the manufacture of explosives. Since then, thanks to the investment of large amounts of foreign capital in Cuba, her large production of sugar has been maintained, but General Machado expressed the view that if the prices of sugar now prevailing in the world should continue, Cuba would be able to keep up her present output only under great difficulties, and eventually a scarcity of sugar might come about with its inconveniences to the consumer at large. Many persons, he said, believed that Cuba's sugar production might be still further increased; but this was an error. Cuba in his view had obtained almost its maximum production this crop. Not all the lands in Cuba are suitable for cane cultivation with sufficient economic returns, and amongst the lands already under cane many are in a state of exhaustion for the further growing of cane, and it will be necessary to devote them to other crops. American producers need not therefore fear any further expansion of Cuba's cane crop. Incidentally, the General urged as a means of assisting the Cuban cane sugar industry that the preferential percentage granted to her imports into the United States should be increased.

The impending exhaustion of the Cuban sugar cane soils, foreshadowed in the above speech, need cause no surprise to anyone who has paid careful attention to the opinions of those best qualified to judge. That the methods followed have, in a great many cases, been contrary to all sound agricultural practice is well known; and it may well be that the time has at length come when the inevitable result is in sight. But, all the same, one might well hesitate to accept the opinion expressed that Cuba has reached its high water mark in production; and this especially in view of the concluding part of the last paragraph, which rather suggests a wish to make capital out of the point of view adopted in the way of better terms in the "preferential percentage." Be that as it may, there are many reasons why it is inadvisable for any one country to dominate the market for any essential raw material, and there appears to be some danger of Cuba's making a bid for this position as regards sugar. Such dominations are evident in a great many staples, e.g., Brazil with coffee, the Southern United States with cotton, cacao on the Gold Coast, rice from Burma, jute in Bengal, quinine in Java, and so on; and it becomes an interesting question for the economist to explore whether such concentrations are for the good, either of the world in general or of the particular producing country.

That Cuba is in earnest in mending her ways appears from the fact, which we glean from a contemporary, that in order to encourage better cultivation a bill has been prepared proposing the establishment of five prizes of $80,000 each for distribution among the first planters who successfully plant, cultivate, and grind sugar cane on 20 caballerias (about 666 acres) during four consecutive cropping seasons.

"Refined" Sugar Production in Porto Rico.

A communication from Porto Rico to *Facts about Sugar* states that after careful investigation extending over several months Central Mercedita, owned by Sucesion J. Serralles, has decided to embark on the manufacture of the best grade of direct consumption sugar, using the Suchar process which has been in successful operation in Louisiana for the past two years. The owners have signed a contract with the Suchar Process Corporation of New York for the building of a complete up-to-date "refinery" costing about £200,000. This "refinery" (which of course is not the standard type of bonechar establishment but the necessary addition to the raw sugar house to enable the liquors to be decolorized) will be capable of producing 250 tons of standard granulated sugar per diem, and it is intended to operate it throughout the year.

At present Mercedita is using the Petree-Dorr process which produces a fine grade of raw sugar. It is proposed to put these sugars through the Suchar process for the final refining, as soon as the new plant is ready, which will be next winter. This latter is being supplied by the Turl Iron & Car Company of New York, who have acquired the sales rights of the Suchar Process for the West Indies.

As is known, Suchar is the name given to a highly activated carbon that has the property of purifying sugar juices similarly to boneblack, but it is claimed, at much lower cost, since the quantity required for a given amount of sugar or juice is only about one-fiftieth as much as in the case of boneblack, and a smaller amount of fuel is required. No additional water supply is needed. Great improvements have been made by the Sugar Process Corporation in automatic filtration and revivification, upon which processes they have expended considerable time and money; and the present experiment is doubtless their first attempt to put the process to work on a large practical scale.

This step upon the part of the owners of Central Mercedita may well mark a new era in the production of sugar in Porto Rico (and elsewhere), since it breaks the hitherto undisturbed sway of the producer of 96° raw crystals, and if successful will almost certainly be extended to other factories. The Porto Rican authorities are said to be greatly interested in the venture, as they consider that its extension will lead to a more even labour balance by giving employment to workers throughout the year. This is a consideration that will attract interest also in other producing centres, Mauritius for example.

Cuban factory owners are likewise bound to watch the experiment with considerable interest, since Cuba has so far never attempted to produce high grade white sugar ; the matter has been investigated from time to time, but there has not been enough incentive to drop the production of 96° raw sugars in favour of washed crystals of the Java sorts, all the more so because the powerful interests of the American refineries proper have been thrown in the scale against the change. But the Mercedita experiment, with the Petree-Dorr process and Suchar, marks a considerable advance on existing processes of producing direct consumption sugar; and if it fully justifies itself, as it probably will, there should be a strong incentive to introduce it into Cuba also.

Entomological Work in Fiji.

Through the courtesy of the scientific officers of the Colonial Sugar Refining Company, a set of six reports, dealing with the pests of the sugar cane in Fiji, has recently been received. And as they contain in them an epitome of the entomological work which has been carried out during recent years in this comparatively isolated and little known sugar tract, a summary has been attempted under "Recent Work in Cane Agriculture." As will be seen from the titles of the two first sections, dealt with in the present number, the cane pests, as might perhaps have been expected, are somewhat different from those met with in other countries. Thus undoubtedly the major pest in Fiji is the wireworm ; and the inclusion of the hornet will appear somewhat strange. In the later sections the cane beetle borer and the white grub are dealt with, and their relative importance differs considerably from that in, say, the Australian fields not so very far away. These will be summarized in a future number.

These six reports, which are framed in the convenient form of bulletins, are written in semi-popular language, although including many details in each case as to origin and distribution, life history, relative destructiveness, and such remedial measures as may be locally applied. Each pest has at least one illustrative plate devoted to it. These have been prepared with obvious care, under the direction, it is presumed, of the entomologist, but bearing the name of E. H. ZECK, and they strike one as particularly clear and informative. The individual pictures are considerably enlarged, but each has an added outline of the actual size of the part or stage drawn. It is a relief to meet with such careful black and white drawings, in place of the current photographs, which with all their advantages frequently leave one in doubt as to certain points. On the whole, this series of reports appear to us to be well adapted to the purpose in view, namely, to make it easy for any planter at once to determine the insect enemies in his fields, and to obtain valuable information as to their character and relative destructiveness, with first-hand advice as to how to deal with them.

Aeroplane Control of Insect Pests.

An interesting article in the Manila *Sugar News*[1] by R. L. PENDLETON discusses the present practibility of using aeroplanes to control insect pests, especially locusts, first as a means to hunt them out and drive them to suitable grounds, and then as a quick and ready means of spreading poison in dust form (usually calcium arsenate) on the vegetation on which the locusts are resting. As is known, the U.S. Department of Agriculture has been for the past three years seriously engaged in experimenting with the use of aeroplanes for poisoning insect pests in the cotton belt of the southern states. The most important conclusion thus far arrived at by them is that under proper conditions the method of using aeroplanes is fundamentally sound; aeroplane dusting is certainly still in an experimental stage, but the main features of whether or not it is successful and profitable have most decidedly passed that stage.

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[1] Vol. VI, No. 4, 186-193.

In the Philippines, the U.S. Army air service has recently carried out experiments on similar lines for dealing with the locust menace in those islands. Two groups of experiments were conducted, one during moist weather in October and November, and the other during the drier weather from February to April. Locusts, it was found, usually select for breeding places a grassy knoll when in mountainous country and flats when in the open, being very seldom found in timbered or brush country. This makes it possible for an aeroplane to get at them and dust them effectively. Some areas affected were in high grass which made it almost impossible to use the older methods of repression, but very adaptable to use the aeroplane. Dusting in the path of travel is essential and the most effective dusting was found to be produced in the late afternoon, after the wind had died down and the hoppers had settled for the night. An altitude of 10 to 15 ft. was incidentally found to be the most effective for carefully controlling the dust clouds, and the amount of calcium arsenate to use per hectare was found to be about 14 lbs. If the dusting was well done and the dust cloud controlled, the poison was 100 per cent. effective against the hoppers if they were over four days old. But much difficulty was experienced in the devising of suitable mechanical contrivances for the uniform distribution of the dust. The experiments in the moist months appeared to be more successful than in the dry ones; in the latter strong winds, which made the control of the dust cloud difficult, the dryness of the vegetation, the scantiness of green grass, were all disadvantages, and double the quantity of poison was needed. But the general conclusions of both sets of experiments were that the aeroplane furnishes the surest and quickest means for observation, communication and transportation of nearly everything needed for a locust campaign; is the most effective method of driving locust swarms, doing the work of thousands of men much more effectively and in much less time; and that the dusting poison, calcium arsenate, will kill hoppers in all stages over four days old and fliers too if the poison can be spread on the vegetation where they are settled for the night; the effectiveness, however, depends on proper distribution and the amount of vegetation available.

Mr. PENDLETON also goes into the larger question of the most suitable type of aeroplane to use, and the probable cost of equipping a district with an aeroplane service for combatting insect pests. The job is not of course adaptable for operation by the individual farmer; either contract operation or operation by a group of farmers acting co-operatively would be necessary. Operating costs though heavy are generally rather decidedly in favour of the aeroplane. It is not necessary to go into detail here as to the conjectures of costs put forward by Mr. PENDLETON, but it may be noted that he thinks it perfectly feasible to run an adequate fleet of planes and keep the staff needed to control the locust situation in the Philippines. Suitable planes and a competent staff are, however, a sine quâ non.

Notes and Comments.

The Spread of Cane Mosaic in the West Indies.

Mr. R. A. Altson, B.Sc., the British Guiana Government Mycologist, recently paid a visit to Jamaica, Costa Rica and Trinidad, and recounts his experiences in the *Journal of the Board of Agriculture of British Guiana.* The mosaic problem in Jamaica he considers the most serious the planters there have to contend with. We have already given in our pages some account of the spread of this disease in that island,[1] based on the reports of the Department of Agriculture. In some cases 100 per cent. of the canes are infected and the spread of the disease is very rapid. Mr. Altson quotes the case of an experiment carried out a year or two ago where a small island of virgin land lying in the middle of a river flowing through a mosaic-infected valley was planted up with tops brought from non-infected districts fifty miles away. By the time these plants were ready for cutting all were found to have become infected, the disease having spread across the river from the surrounding cane fields. Mosaic, as Mr. Altson points out, can be spread not only by the planting of infected tops but also by insect transmission. But the loss of tonnage due to the former method of infection is considerably in excess of that due to the other, for in the case of infected tops the plants are subject to the effects of the disease from the initial stage of their growth. The importance then of early recognition of the presence of the disease in a cane area stands self-evident.

As giving some idea of the loss that the disease is causing in Jamaica, Mr. Altson quotes the experience of a planter (Mr. F. L. de Pass) who has been contending with mosaic for the past eight years. The latter concludes that it is possible to grow, with intensive cultivation, a good plant crop, but the ratoons are and always will be a ghastly failure since they will not benefit by either cultivation or the application of manures, and, after the first ratoons, are not worth keeping on. By careful roguing an infection of less than 5 per cent. can be controlled but not eradicated [*sic*]. To do this it is necessary to have at least one man for every 20 acres, as after a couple of hours colour blindness sets in. The loss incurred from a 100 per cent. infection he found to be not less than 50 per cent., while the cost of cultivation is increased a like amount. The cost of an acre of plant canes previous to the entry of mosaic was £10 per acre. This yielded from 25 to 40 tons of cane as plants and ratooned for from five to six years, being replanted when the yield dropped below 15 tons. To-day it is impossible, Mr. de Pass finds, to produce any crop of plants at less than £20 per acre, this being due to the tops dying, and so having to "supply" three or four times, while the plants grow so slowly that numerous extra weedings are required.

Mr. Altson mentions that cane mosaic has not yet being reported in British Guiana; but the disease is known to be present in the adjoining colony of Surinam, and this circumstance suggests to him that it would be advisable to carry out a detailed inspection of the cane cultivations in British Guiana, so as to make certain that unrecognized introduction has not already occurred.

Death of Mr. T. D. Chataway.

Readers of our journal will join with us in regretting the death in March last of Mr. Thomas D. Chataway, our able Australian correspondent. His regular contributions on the Australian sugar industry were well-informed and succinct reviews of the state of affairs in that Dominion and were invariably interesting to read. He was an experienced journalist and having spent a good deal of his life in Queensland (where for 10 years he conducted in collaboration with his brother a sugar journal at Mackay) he was naturally unusually well-informed in regard to sugar matters. His death removes one of our most valued correspondents.

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[1] *I.S.J.*, 1924, 474.

T. D. CHATAWAY (as our contemporary, the *Australian Sugar Journal*, states in its obituary notice) represented Queensland in the Senate from 1906 to 1913. When adverse circumstances led to his sugar journal ceasing to appear, he was editor for some time of the *Mackay Mercury* and did good work for the district in that capacity. Latterly he took up his residence in Melbourne, where he acted as correspondent for numerous papers and journals. He was the son of the late Rev. JAMES CHATAWAY, rector of Rotherwick, Hants, and was educated at Winchester. He went to Queensland as far back as the early eighties, so has been associated with Australian sugar all his adult life.

Beet Sugar Manufacture at Greenock.

A Company has recently been formed under the title of "The Orchard Sugar Company Ltd." to take over the Greenock refinery of the Orchard Sugar Refining Company and use it after suitable re-arrangement of the plant as a beet sugar factory, capable of treating 500 tons of roots per day. The contract for additional buildings and equipment has been made with Messrs. John McNeil & Co. Ltd., of Govan, and will cost £130,000. It is to be completed in time for the autumn campaign this year. The Company has already obtained contracts to grow beet for the factory from about 1500 acres and the total area for the coming season is expected to attain to 2000 acres, while a maximum of 5000 eventually is aimed at. The 1925-26 crop is expected to yield 2000 tons of sugar, and in the subsequent 8 years the Directors look to obtaining an annual output of fully 5000 tons, while the factory itself is designed so that it can be increased to turn out 8000 tons in a working season if enough roots are forthcoming.

The directors of the new Company are Mr. WILLIAM HENRY GOFF, chartered accountant, of Glasgow; Mr. ANDREW RICHARDSON GRIEVE, sugar refiner, of Greenock; Mr. JAMES REID KERR, sugar refiner, of Greenock; and Mr. ROBERT GRAHAM NAPIER, chartered accountant, of Glasgow. The price being paid for the old Orchard refinery property is £70,000, of which £30,000 will be in cash and the remaining £40,000 will be taken in the form of ordinary shares in the new Company. The capital of the latter is £170,000, consisting of 120,000 ordinary shares of £1 each and 50,000 7½ per cent. cumulative participating preference shares of £1 each. A public issue at par of the latter shares and 80,000 ordinary shares was made last month, the remaining 40,000 ordinary shares being taken by the vendors as part of the purchase consideration.

Sugar Beet Experiments in Scotland.

A year ago a Committee was appointed by the Scottish Council of Agriculture to enquire into the possibility of developing a sugar beet industry in Scotland; its report has just lately been issued and on the whole is favourable to the extension of this industry to Scotland, it having been proved that beets can be grown there. But the result of experimental trials in various parts of Scotland, including the northern counties of Aberdeen, Moray, Nairn and Banff, suggests that further investigations and more knowledge and experience of the methods of cultivation needed are required by the growers ere the enterprise can be considered ready for commercial development. Careful and systematic experiment is also required to establish the best period for seed time. Most of the experimental beet crops grown of late have been sent by rail to the Anglo-Scottish Beet Sugar Corporation's Colwick factory in England, this corporation having offered special facilities to farmers in different localities to cultivate small areas of beets. It would appear, then, that while the climate in Scotland has not so far been shown to be any obstacle to growing roots up to Continental standards, the natural lack of experience of the farmers must first be overcome by prolonged trials extending over some seasons ere it is safe to embark on a commercial enterprise. There is of course the Greenock experiment referred to above, but this is a case of adapting an existing establishment not in erecting a new one, and it remains to be seen whether agriculturists in that neighbourhood will support the factory with sufficient consistence and in sufficient quantity to yield the anticipated returns.

Sugar Crops of the World.

Since we gave last month Willett & Gray's estimates of the sugar crops of the world, this eminent firm of statisticians have increased the grand total further by 163,000 tons. The latest estimates now give the 1924-25 crops as 22,886,532 long tons, of which cane accounts for 14,701,147 tons, European beet for 7,175,000 tons, and U.S. and Canadian beet for 1,010,385 tons. The Cuban crop is estimated at the huge figure of 4,925,000 tons, and Hawaii at 647,000 tons.

Incidentally, Messrs. Willett & Gray, have taken from their records some interesting figures showing the wonderful increase in sugar production throughout the world during the past 75 years. From them we quote the following:—In 1853 the total sugar production of the world was 1,481,000 long tons, of which 1,277,000 was cane and 204,000 tons beet sugar, which latter crop was produced in only five European countries—Germany, Austria, France, Belgium and Russia. An interesting feature of cane production that year was that the Louisiana crop was the second largest in the world, the Cuban crop being first at 322,000 tons and Louisiana second at 225,000 tons. Java in this year produced 100,000 tons.

In 1863 the world's production had increased to 1,962,000 long tons, of which cane amounted to 1,484,000 tons and beet 478,000 tons. Owing to the American Civil War, the Louisiana crop was completely destroyed, there being no crop of any appreciable size made at that time. Meantime the Cuban crop had increased to 507,000 tons and the second place in the world's production was taken by Brazil, whose crop rose to 238,000 tons.

The world's crops had increased to 3,128,000 tons in 1873, of which cane amounted to 1,840,000 tons and beet 1,288,000 tons. The Cuban crop that year was 775,000 tons, while the Louisiana crop had improved somewhat after the disasters of the Civil War and amounted to 59,000 tons. The world's production did not reach 5,000,000 tons until 1886, when the outturn was 5,042,600 tons, and the Cuban crop amounted to 732,000 tons.

We regret to learn that Dr. H. C. Prinsen Geerligs, who went on a trip to Cuba last January, had a serious breakdown in health which cut short his trip and necessitated his return home to a cooler climate. The latest report of him is that he is progressing slowly, but it will be some considerable time before he is convalescent.

We regret to announce the death on February 23rd of Mr Frank P. Rudder, M.I.M.E., on board the S.S. "Camito," en route from Trinidad to Jamaica. Mr. Rudder was Advising Engineer to Messrs. Henckell, Du Buisson & Co. (general managers of the St. Madeleine Sugar Co., Ltd., the Antigua Sugar Co., Ltd., and the St. Kitts Sugar Factory Co., Ltd.) He was recognized as a particularly clever engineer, and especially as an expert on fuel economy in the cane sugar factory. He was formerly with Messrs. George Fletcher & Co., Ltd., of Derby, and while a director of that firm he superintended the erection of the largest sugar refinery in Australia.

Fifty Years Ago.

From the "Sugar Cane," June, 1875.

An annual report was here published appertaining to the central factories of Martinique, which were considered at that time to represent the most advanced practice; and so, to show the nature of the returns obtainable half a century ago, the following figures representing one of them (Robert) are reproduced: Cane crushed, 21,300 tons; sugars made (first, second, and third), 1424; total sugars made, per cent. cane, 6·70; rum made, 62,926 gall.; sugars in sugars and molasses sent to the distillery, not stated; tons of cane for one ton of the sugars made, 15·0; total receipts from sugars and rum, £41,503; expenses (including cane, labour, cooperage, factory maintenance, chemicals, etc.), £32,777; and nett profits on the crop, £8726, which on the capitalization of the factory represented about 15 per cent. Sugar for export to France was sold at 23s. 10d. per cwt., and locally for 31s. 7d.

G. C. Stewart, a chemist of Greenock, contributed "Notes on Sugar Analysis," reproducing a number of figures showing the composition of the refining sugars of his time. He ascertained the "crystallizable sugar," or sucrose as it is now called, volumetrically using Fehling's solution before and after inversion by heating with dilute hydrochloric acid, the difference multiplied by 0·95 giving the result. "Non-crystallizable sugar" or reducing sugar, was found from the same determination; whilst other figures returned in his analyses were for "extractive organic matter," "insoluble organic matter," sand and clay, soluble and alkaline salts, peroxide of iron, and lastly moisture. Only one of the cane sugars tabulated here had a sugar content of 96°, the others being in the neighbourhood of 90 or lower.

An account was given of the opening by Hawksworth Brothers of what was called a "central" factory, at Equeefa, Alexandra County, Natal. This was described as being of a "superior" type of sugar-house, and doubtless it was then, though, judged by present average standards, it must have been a diminutive affair with its 20 in. mills, two wetzels, and two centrifugals. It was made by Duncan Stewart & Co., of Glasgow, and was the first supplied by that well-known firm to the colony.

Under the heading of "New Patents" a number of specifications were noticed in this issue, along with them for the first time some American ones. George Fletcher, of Derby, described improvements in the construction of centrifugals and of pumps; Paul L. Manbré, a process consisting of moistening starch with acidulated water so as to convert it into gum, or a compound containing 25 to 75 per cent. of glucose, or again into pure glucose, this process dispensing with the usual preliminary boiling with dilute acid; John O. Donner, a centrifugal machine for swinging moulds containing sugar; Wm. B. Espeut, a system of using charcoal by filter-pressing; John M. Lescale, of Paincourtville, Louisiana, a sulphiting apparatus in which spiral revolving wings elevated the SO_2 against the falling juice; and lastly F. Randon, of New Orleans, an evaporator in which the juice fell from a reservoir in a fine stream upon a "deflector" (consisting of the top of a heating chamber) into a tray below, from whence it was re-pumped to the reservoir for the repetition of the process until the desired concentration was attained. This latter invention therefore so far as one can judge by the very brief description given might probably be described as a predecessor of the Yaryan type of apparatus.

White Grub in Queensland Cane Fields.

Various hints have been recently received that the long drawn out struggle between the Entomological officers in Queensland and the white grub which, while always to be reckoned with in the cane fields, has at times assumed a devastating character, is within sight of a successful issue. It is devoutly hoped that this may be the case, especially in the Cairns district, where the losses caused in the fields are estimated at hundreds of thousands of tons of cane each year. But, considering the natural history of this pest, and the enormous reserves it has at its disposal in the vast areas of "bush" (grass land under *Imperata arundinacea*), adjoining the cane tract, it is obvious that, even when a destructive treatment is made available, an additional annual charge will be made on the costs of cultivation. Unless the forces of nature themselves are brought under contribution, for instance by the spread of natural enemies, the pest will have to be carefully watched and fought against year by year; and the least remissness will very likely be bitterly regretted. Great caution is therefore necessary in assuming that Queensland is at the end of her white grub troubles.

The suggestion referred to above that this may be so is undoubtedly to be traced to a statement in the latest Report by the Government Entomologist, Mr. EDMUND JARVIS; and while it would appear from the facts disclosed to be perfectly justified, this statement is carefully guarded in another paragraph which should be read in conjunction with it. There are in fact two outstanding causes for encouragement, namely, that there has been a great decrease in the infestation during the past two or three seasons, and that the trials of paradichlorobenzene as a soil fumigant have been crowned with quite remarkable success. But it would be the greatest mistake to assume that these two causes are interdependent. The state of affairs is very clearly set out in the last two Reports written by JARVIS, and is worthy of a careful analysis.

The decrease in numbers of the white grub in the fields is shown to be due to exceptional climatic conditions. Unusual droughts have occurred recently at the commencement of the growing period (September to January); and consequently the hardness of the ground has made it impossible for the cane beetles to emerge, as they are accustomed to do during this period, and thus lay their eggs and infest the crop of sugar cane with their grubs. "The beetles usually emerge from the pupae in October, remaining, however, in their subterranean pupal chambers for three or four weeks, until thunder showers, which generally arrive about the middle of November, have moistened the hard, dry soil sufficiently for them to tunnel to the surface. Unless rain falls before the first or second week in December, countless numbers must inevitably perish through inability to reach the feeding trees." In the Cairns district the rainfall was 0·1 in. in November, 1922, instead of the average of 4·13, and during December 1·97 in place of 9 19; the total from September till January was 7·65 ins. as against the average of 35·71. In 1923 the situation was a little easier (for the grubs) in that 15·73 ins. fell instead of the (new) average of 33·42. But again a chance factor operated against the beetles, in that they appeared in the pupal chambers earlier than usual in this second season of drought, which made the November drought a far more critical matter than normally; and there was only 0·6 in. of rain during this month in place of the average of 4·05. In considering these facts the author writes his warning paragraph: "It is well to bear in mind that, when normal seasons again prevail, there is every possibility of this destructive cane beetle manifesting its usual activity, more particularly in those districts where practical control measures, such as collecting the grubs and beetles, have been altogether abandoned."

And it may be here remarked that it is quite possible that the effect of the last two years of drought on the numbers of beetles in the cane fields may last for a certain time after the return to normal weather conditions, and may thus engender a false sense of security. For it has been observed on various occasions in the past that, after a temporary check, whatever be the cause, it may take years before infestation in quantity again occurs. This fact suggests that we have not, as one would suppose, to do with an annual flight from their natural haunts to the cane fields, but rather that the infestation is from cane field to cane field; so that, once the local supplies have been cut off, the invasion from wild grass land to cultivated fields must take place afresh, say, by the blowing of prevailing winds or the wandering of a few strong fliers into a region of unexpectedly suitable earth conditions for the laying of the eggs. And it would be from such foci of infection that the new broods would in time develop. If this surmise be correct, namely that a certain amount of acclimatization has to take place, it would merely emphasize rather than diminish the necessity of continuing the weary repressive measures of collecting the beetles and fumigating the soil, in spite of the temporary waning in numbers of the grubs in the fields.

With the data available to the writer of this article it is a little difficult to deal historically with the question of paradichlorobenzene, whose application as a fumigant has led to such an outburst of optimism in the latest Report of the Entomologist as is quoted at the end of this article. Suffice it to say that a sample of this substance appears to have been forwarded to JARVIS for trial as long ago as November, 1914; and that its experimental success as a soil fumigant in killing the grubs and as a repellant against egg-laying was published in the Monthly Notes of the Entomologist in April, 1915.[1] Comprehensive reports were apparently written for local agricultural periodicals of the time; but no reference has been found to this substance in the list of soil fumigants tried in the 1920 or 1921 Reports written by ILLINGWORTH, and published in the Annual Reports of the Queensland Bureau of Experiment Stations. It is, however, again mentioned by JARVIS, in his 1922 Report, as the most promising fumigant tried in the plot experiments; and he states there that field experiments had been laid down for corroboration on a larger scale.

The substance appears to exist in two closely allied forms, a liquid which is termed ortho-dichlorobenzene, and a solid called para-dichlorobenzene (abbreviated for obvious reasons to paradichlor). The former, although cheaper, is less handy and has the disadvantage of completely evaporating in a few hours, whereas the latter retains its repellant aroma for from six to eight weeks. And it was this second form which was used in 1915, although under the name of dichlorbenzole.[2]

The results of the field trials referred to above are described in some detail by JARVIS in his 1923 Report, and are sufficiently interesting to be worth abstracting. The experiment was made on a ridge of friable red volcanic soil with poor cultivation, 605 ft. long, and embraced eight rows of first ratoons of D 1135. The field had not ratooned well because of injury received from drought coupled with infestation by white grub in the previous season; and when treated with paradichlor in January the plants were 2 to 3 ft. high, with gaps of several feet in places, while in other places the ratoons were weakly or stunted. Injections of ¼ oz. of paradichlor were made on both sides of the rows, 12 to 18 ins. apart, 6 ins. deep, and 4 from the lines of cane plants. Examined a fortnight later, the odour was noticed from the surface to a depth of about 7 ins., and 9 or 10 on each side of the hole; and it was estimated that this result was obtained with the loss of only one-sixth of the original dose. Three months after the application the canes were 7 to 8 ft. high; in the infested patches the treated plants were dark green and the untreated pale yellow. This difference could be readily noticed on looking down on the field from a height of 10 to 12 ft., the treated plots being sharply separated by their colour from the untreated. As a matter of fact, a few isolated yellowish patches could be seen in the treated plots, but these on investigation were at once seen to be stools which from carelessness had been accidentally missed by the fumigators. Where the work was thoroughly done an unbroken line of dark green stood out from the adjoining untreated row, only 4 ft. 6 in. away, of stunted, yellow, grub-eaten cane. Four plots of 900 stools each were submitted to an analysis of infestation, with the following results:—Plot No. 1, of three rows treated, gave only 20 stools with grubs; while plot No. 2, of three rows untreated, gave 575 stools affected by grub; and the corresponding numbers for plots 3 and 4, treated and untreated, were 49 and 779.

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[1] Notes on Queensland Cane Insects and their Control. EDMUND JARVIS. Division of Entomology, Bulletin No, 17, 1923.

[2] *I.S.J.*, 1916, 427.

The canes were cut 7½ months after fumigation, during which only half the usual rain had fallen. The canes on the injected plots remained green, were upright and considerably higher than those alongside in the untreated plots. Photographs were taken at the time, and these were reproduced in the *Australian Sugar Journal.* Lastly, about a month after the crop was cut, the fumigated rows were reported to have ratooned evenly all along, while the untreated plots had very few shoots showing, and these were uneven and stunted. Another point had been noticed at the beginning of the trial which was carefully investigated, namely, that about a fortnight after the injection of paradichlor the plants so treated showed a browning of two or three of the older leaves in each clump, from the tip downwards for a distance of about 8 to 12 ins., an appearance which passed quickly away as the unaffected inner leaves grew out. This was supposed to be due to cases where some of the roots were injured or bruised in the carrying out of the injection, the chemical thus entering the injured roots; but it was considered worthy of further study.

During the succeeding year (1923-24), 15 additional experimental plots were laid down in seven different places, the canes grown being Badila, D 1135, and Clark's Seedling. The object aimed at was not only to test the effect of the paradichlor on white grub, but also on the rooting system and ultimate growth of the cane plant itself.

The results in the second year were in full accordance with those given above. Doses of one-sixteenth to one quarter of an ounce were given at an average depth of 4½ ins., 12 to 18 ins. apart, and 6 ins. from the centre line of the cane plants. The treated plants were exempt from grub attack, while the untreated turned yellow and in some cases gradually fell over. On examining the latter, it was found that the stools had been practically eaten out of the ground, and parted with the soil with a slight pull. It was also noted that in fields free from white grub the treated as well as the untreated rows showed cane plants of uniform height, colour and general appearance; showing conclusively that the treatment had not affected the development of the cane. Being non-poisonous, non-inflammable, cheap and clean to handle, paradichlor is considered an ideal remedy against soil-frequenting larvæ of cockchafer beetles, termites, root borers, etc. And as the result of these experiments, the author reports that he is able to announce that the worst insect enemy in the cane fields, the dreaded grey-back cockchafer, *Lepidoderma albohirtum,* has been brought under control, thus effecting a saving of hundreds of thousands of pounds.

C. A. B.

Synthetic Farmyard Manure.[1]

By Prof. F. HARDY, M.A.

Through the courtesy of Mr. E. HANNAFORD RICHARDS, B.Sc., F.I.C., Managing Director of the Agricultural Developments Company, we are able to publish further details of the Adco process, and to make certain amendments to former articles which have appeared in this journal (Vol. 1, No. 8, August, and No. 9, September, 1924, pp. 116 and 133).

At the outset, it is necessary to state that the proprietors of the Adco process now desire to describe their product as *synthetic* rather than artificial manure, since this term has given the erroneous impression that the material is of an inorganic or chemical nature, whereas actually it comprises very nearly the same components as farmyard manure (in particular the valuable organic matter), with the difference that its ingredients have been synthesized or built up from the same main raw material as farmyard manure by the agency of added bacterial stimulants, but without the intervention of farm animals.

As a result of recent investigations, it has been demonstrated that the decomposition of plant residues, through the activity of micro-organisms, takes place in several stages. First of all, sugars, pentosans, and starches are consumed by a variety of organisms, notably fungi. It seems likely that these carbohydrates are built up into living cell material (protein), which is itself broken down at a later stage, providing the most available type of organic matter in the finished manure. Cellulose itself decays comparatively slowly, and may be regarded as a "scaffold" supporting and distributing the decomposition products of the other simpler carbohydrates. Contrary to former opinion, it has also now been proved that reducing sugars in moderate amount, and higher nitrogen compounds (if not bactericidal), actually assist rather than hinder the formation of a satisfactory manure.

In common with all living plants, the micro-organisms concerned in cellulosic fermentation require nitrogen for their sustenance. Frequently, the amount of nitrogen contained in the raw material upon which they act is insufficient for their needs. Consequently, it is necessary to add nitrogenous compounds to augment the supply naturally present, if a satisfactory fermentation is to be obtained. In the case of cereal straw, usually 0·7 per cent. of nitrogen, measured on the dry weight of the straw, is required to make up this deficit. For cane trash, the necessary amount is probably nearly the same. The additional nitrogen may be supplied in the form of some inorganic nitrogenous compound (Adco process), or as urea contained in the urine of farm animals (Mauritian method, as well as the ordinary farmyard or pen manure process).

In their earliest experiments, the Rothamsted investigators used ammonium carbonate as a source of nitrogen, but for reasons of cost, sulphate of ammonia was employed in later large scale trials. This gave fairly good results, but its sulphuric acid content was objectionable, while the high solubility of the salt led to accidental loss in distribution. Mr. RICHARDS states that for two years past the Adco Company has manufactured its own reagent, which contains no sulphate of ammonia. The new reagent ensures a neutral or slightly alkaline fermentation, while the phosphate-nitrogen ratio in the finished manure is greatly improved. The formula of the reagent has not yet been divulged.

The extent to which fixation of *atmospheric nitrogen* may proceed during the manufacture of synthetic manure, through the agency of specific micro-organisms, has apparently been unduly exaggerated. Mr. RICHARDS' laboratory experiments, commenced in 1915, and repeated with the co-operation of Dr. HUTCHINSON in 1918-19, have conclusively shown that, even under the most ideal conditions, the actual gain due to the fixation of atmospheric nitrogen, seldom exceeds 0·5 per cent. of the dry weight of the straw employed as raw material. Usually it is much less. In large scale trials with straw heaps, the maximum gain was found to be only 0·1 per cent. Thus little additional advantage can be expected from the co-operation of atmospheric nitrogen fixers.

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[1] Reproduced from *Tropical Agriculture* II, No. 5, 1925.

In the manufacture of synthetic manure by the Mauritian method, the writer found that the increase in nitrogen over that contained in ordinary Trinidadian pen manure, was only about 0·036 per cent. of the weight of the final manure, or about 0·156 per cent. of its dry weight, which amply agrees with Mr. RICHARDS' experience.

The fact that the increase in nitrogen due to atmospheric nitrogen fixers is relatively small, is explained on the grounds that there is usually only a limited amount of suitable carbohydrate (sugar, pentosan starch) available for the nourishment of the micro-organisms that can assimilate either atmospheric nitrogen or chemically combined nitrogen, and that, when this supply has been exhausted, no further assimilation can occur. Consequently, fermentation then proceeds very slowly.

On the other hand, if the supply of suitable simple carbohydrate in the raw material is considerable, but at the same time the amount of nitrogen present in the manure is insufficient, the nitrogen assimilating micro-organisms may draw on the reserves of nitrate nitrogen *in the soil*, and the manure may then exert a depressing effect on crop yield when first applied to the land. Herein lies the danger of employing too much cellulostic litter in the manufacture of ordinary farmyard manure, and indeed of Mauritian pen manure also.

For obvious reasons, it is not easy to arrange the proper balance of nitrogen to carbohydrate when manure is made by treading litter under stock. On the other hand, once the normal composition of the raw material has been determined, the Adco process enables a well-balanced manure to be produced without any risk of those losses of valuable fertilizing constituents which are generally recognized as inevitable under the older systems.

This, then, is the secret of the Adco process. By means of a long series of laboratory experiments augmented by numerous large-scale trials, the Rothamsted workers have gradually evolved a formula and a mode of operation which yield results that are highly satisfactory in respect to the manurial quality of the final product. It only remains to be seen whether or no the use of Adco synthetic manure compares favourably with other systems of manuring when considered in economic aspect. Various trials are being made, not only in Great Britain, but in many tropical and sub-tropical countries as well, in order to settle this question, and it may interest our readers to learn that large scale trials will probably soon be inaugurated in Trinidad under the joint auspices of the Trinidad Department of Agriculture and the Imperial College of Tropical Agriculture. The results of these trials, when available, will be published in due course.

"Corn Syrup" is re-defined by the Canadian Food and Drugs Act[1] as "a mixture of glucose with sugar syrup (sugar cane syrup, sorghum syrup molasses, refiners' syrup, treacle, etc.), with or without the addition of harmless flavouring substances (the flavour of which must not resemble the flavour of maple), and contains not more than thirty-five (35) per cent. of water and not more three (3) per cent. of ash."

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[1] *The Canada Gazette*, February, 14th, 1925.

Clarification Processes and Plant in Hawaii.[1]

CLARIFICATION RESEARCH.

Following is a summary of recent work carried out in Hawaii, as mainly described in the reports of the Experiment Station:—

Phosphoric acid.—It has been found that juices of low phosphoric acid content do not clarify well; that is, they do not give a satisfactory clarity of juice. The dividing limit has been found to be close on 0·03 per cent. phosphoric oxide (P_2O_5); juices above this usually give a clear juice, and those below the reverse. The condition can be corrected by addition of a phosphoric acid compound to the juice before clarification.

Reaction.—The old control of litmus has been supplanted by the more exact measurement of the hydrogen-ion concentration. This is determined by direct electrolytic measurements, or more conveniently by certain colour reactions. It is found that liming to a definite alkalinity produces the greatest benefit in clarification. Below this point, the results are imperfect and there is the likelihood of loss through inversion of the sucrose due to the acid condition of the juice or the later products; and above this, there is the depression of purity due to the greater amount of lime-salts in solution, and also the danger of destruction of glucose.

Liming.—The lime added as milk-of-lime should be thoroughly and evenly mixed with the juice to be tempered before it is sent to the heaters. If this is not done efficiently, there is a loss of lime due to possible unslaked material. There is also in the usual manner of adding lime to the juice running from the scale tank to a receiving tank, without any provision for agitation, a tendency for the juice in the lower part of the tank to be more alkaline than that in the upper part. It is true that this is all mixed in the settling tanks, but the effectiveness of the liming has been partly lost. This can be corrected either by having an agitation in the receiving tank by air blast or stirrers, or more effectively and much more conveniently by a device like that employed by the Oahu Sugar Factory. This system, which was described in the report of the Committee of Machinery last year, in addition to the important feature of correct and continuous lime addition, provides for a thorough admixture of juice and lime in the juice pump. It also has the valuable condition that a change in liming can be almost immediately controlled from the sample being returned from the juice pump.

Temperature.—For best precipitation and coagulation, a temperature close to the boiling point is best. Where juices must be held for some length of time it has been found that by reducing the temperature of the heaters to between 180° and 190° F., there is less danger of loss of sucrose. The temperature must not be allowed to fall below 165° F., this being the thermal death-point of certain high temperature organisms. A temperature below boiling point, as 190°, makes for slower subsidation, and requires more settling tank capacity and more time in the settlers.

Capacity.—The importance of a sufficiency of lime has been thoroughly proven by the Station. But along with this greater lime addition there is an increased amount of precipitation in the juices. This means that the former standards of settling-tank and filter-press capacity are now inadequate. It is not infrequent that, when settling is retarded, a factory is forced to lower its lime addition below the optimum requirement in order to get away with the material coming from the mill. It would be more profitable to provide sufficient capacity. Time is equally important with alkalinity and heat in securing efficient clarification.

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[1] Report (here abridged) presented to the 43rd Annual Meeting of the Hawaiian Sugar Planters' Association, T. H., 1924.

NEW CLARIFICATION PROCESSES.

Horne's "super-defecation."[1]—This consists essentially in adding sufficient lime to produce maximum precipitation and then taking care of the possible excess in solution by precipitation, with a reagent known as "Amigon," probably a phosphatic compound. The system requires about 60 per cent. more capacity at the settling station and more filter-press capacity. Cost is given as 24 cents per ton of sugar for chemicals, with an additional cost for extra equipment and labour. Claim is made of an increase in purity over the ordinary method of lime alone of 1°. Further benefits stated are a cleaner juice, no sediment deposited later, no scale on evaporator tubes, free boiling, first sugar at 99° polarization, which can be washed up to 99·86 with three gallons water per 40 in. machine, and a second sugar of 96° or better polarization. In a trial this sugar contained only 0·3 per cent. ash; and the molasses ash dropped from 11·53 to 6·26 per cent. While the process promises a better sugar as regards colour and ash for the refinery, the part that is most interesting to the raw sugar manufacturer is the possibility of the increase in purity and better recovery of sugar due to a more perfect clarification. This process should be investigated.

Sorensen's process.[2]—This process is understood by the Committee to mean only the filtration of all the juice after heating through plate-and-frame presses, doing away with the need of settling tanks. It does not present anything distinctly original as this was tried out several years ago locally by a representative of the "Filter-Cel" Company. It is at least a matter of doubt whether the cost of the investment and extra labour and material involved in a filter-press installation large enough to handle all the juice would be compensated for by the advantages that might be derived from the whole juice filtration, where direct consumption sugar is not produced.

JUICE STRAINERS.

The evidence of the advantage of fine straining as noticed during this past crop is contradictory. In some cases a very distinct benefit has resulted; in others, no material advantage is noticeable. In most cases there was more difficulty experienced at the filter-press station; this was overcome by a closer attention to the work at this station, particularly as regards the liming of the settlings. Two factories report very favourably, crediting the strainer with a better increase in clarification, cleaner heating surfaces, cleaner commercial sugar, freer boiling lower grades, a better melt and a lower molasses; and all without any appreciable effect on the filter-press work. One very distinct advantage is reported by one mill when working with dirty cane following periods of heavy rainfall. A sufficient amount of soil was removed during the fine straining to make a sensible easing up on the filter-press operations.

Peck's strainer,[3] has been in operation in seven factories during part or whole of the 1924 season. There have been two changes made in the construction of the apparatus: a coarse supporting screen is placed just below the fine 100-mesh screen, to give it additional support and guard against breakage; and a tray is placed within the drum so as to prevent the strained juice impinging with too great force against the fine screen when in a position not supported by the coarser mesh screen.

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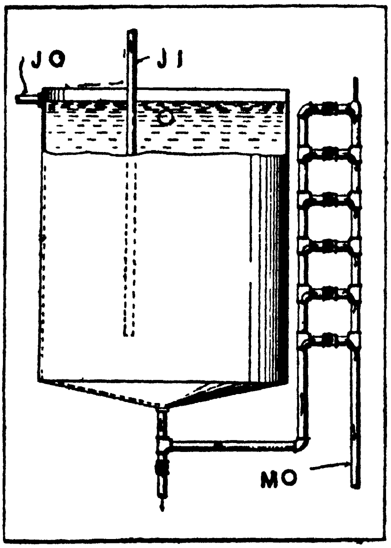
[1] *I.S.J.*, 1924, 453.
[2] *I.S.J.*, 1923, 334.
[3] *I.S.J.*, 1924, 168.

SETTLING TANKS.

The intermittent settling tanks require no further description. Dorr subsiders, or continuous settlers, are finding great favour in other cane sugar producing countries, and there will be 10 in T.H. for the 1925 crop. With the exception of one, these form a part of the Petree process. At Paia, a system of drawing off the settling has been introduced, doing away with the "Dorrco" pump. It was in use during the latter part of last season and worked so successfully that it will be used permanently. The principle of the change is described by J. P. FOSTER as follows:—

"In any juice sedimentation process, sudden changes in velocity of flow should be carefully avoided. There is so little difference between the specific gravity of the organic impurities of cane juices and the specific gravity of the liquid in which they are suspended, that very little disturbance indeed is required to retard or even altogether to prevent proper sedimentation. An undesirable disturbance may be occasioned by incorrect methods of drawing-off either the clear juice or the mud. If the latter is drawn off by gravity flow from the bottom of the settler, a high velocity is apt to be imparted to the draw-off and result in slow sedimentation and high juice dilution of the mud. In the effort to reduce this action pumps have been installed on various types of clarifiers, but without complete success. A centrifugal pump is of necessity a high-speed mechanism and is almost certain to induce high-velocity currents in the settler, and has the further disadvantage of deflocculating the mud on its passage through the pump impellers. A reciprocating pump, while it may avoid setting up high-velocity currents in the settler, will cause a pulsation which, acting through the connecting piping, is transmitted to the settler and to a greater or less extent agitates its entire contents, with maximum effect at the point of exit where freedom from agitation is of greatest importance.



JO = Juice overflow.
JI = Juice outlet.
MO = Mud outlet.

"In order to overcome these difficulties, a device was tried out at Paia which effected a marked improvement in the quality of clarification and in the density of the mud drawn off. The device was in effect an inverted U-tube, one leg of which was connected to the mud outlet of the clarifier, the other leg to the mud piping, while the top of the tube was made to correspond to the level of the juice in the settler. The mud was then allowed to flow off under a gravity head so slight as to reduce its velocity to a minimum. The areas were made very liberal, and in order to compensate for changes in the density of the mud in the ascending leg of the tube, valved connexions were put in between the two legs, as shown in the sketch here reproduced. In other words, only sufficient gravity head was used to overcome the pipe friction. The ease of control and exactness with which it could be effected was no doubt responsible for much of an improvement noted in subsequent operations. Both of our large clarifiers were fitted with the device described and the mud pumps were not used. A new clarifier added this year was ordered without the pumps. The device effects a distinct advance in clarification practice."

FILTER-PRESSES.

It has been found on occasion that good work at the settlers is defeated in its purpose by poor work at the filter-press station. A broken cloth or a leaky press running cloudy, dirty juice into the evaporator supply tank can undo in a few minutes the work of hours at the settlers. The safest expedient to avoid this is to send all the filter-press juice back to the raw juice, there to pass again through the heaters and subsiders. This at once throws additional duty on the settling tanks and additional capacity must be provided. The system has a further advantage in that the quality of the juice sent to the evaporators can be kept at a constant reaction. It is frequently necessary to add additional lime to the settlings in order to produce a cake, and the condition results of two juices—the clarified and filter-press—of different reactions, mixing and going into the effects without any possibility of separation of the precipitate that may form.

A recently completed investigation by the Experiment Station shows that in one factory the press juice, when evaporated to syrup, had a filtration rate three times that of the normal syrup. If all the juice could be filtered, it is very certain that a distinct improvement in the quality of the juice would result, but it is still doubtful whether the final advantage would compensate for the extra expense attached to such a practice. It is infrequently the case that, in order to save the filter-press station, either insufficient time is allowed for sedimentation in the settlers, or the clarified juice is drawn off at a level too close to the body of the settlings. Then some of the lighter particles are carried with the draw-off to the evaporators, contaminating all the juice. The remedy is obvious: Either more settling tanks, or more filter-press capacity.

CENTRIFUGAL SEPARATORS.

Kopke separators present several advantages over the plate-and-frame presses. It is a matter of record that as the sweetening-off of the press proceeds, the resulting liquors are at first of gradually and later of rapidly increasing purity, so that some impurities, once removed, are again sent back into process. There are also considerable losses of heat at the presses. In addition, there is a cost of filter-press cloth and of labour. The Kopke separators provide for a rapid liquidation of the settlings. Within a few minutes after being discharged from the settling tanks, the juice is back into process. This means a saving of heat and losses due to the deterioration of the liquors held by the mud. For best work the settlings must be limed to an alkalinity greater than required for optimum clarification, so that the separated liquors must be returned to the raw juice. This has the same advantage as already mentioned; any turbid or dirty juice liberated by the separators must go through the subsiders. There is the complete saving in filter-press cloth and a saving in labour which is not yet determined. How far these savings will be offset by the cost of upkeep of the machines is also a question which must yet be answered.

Six separators were in use the latter part of the season at the factory of the Hawaiian Commercial and Sugar Company. The machines are belt-driven from 15 h.p. 1750 r.p.m. motors, the speed of the centrifugal being 1225 r.p.m. It required three men per shift to operate the station. The feeding to the machines is controlled by a nozzle designed to admit approximately 15 galls. per min., which can be increased or diminished at will by raising or lowering a boat in a supply tank. The time required for filling and discharging mud was ten minutes. The separation was very good, the run-off being quite clear and of the same purity as the juice entering. Settlings were limed before passing to the machines, and the separated juice returned to the raw juice. The machines were only about 65 per cent. of the capacity required, and consequently the full benefit of the operation was not ascertained. The results were encouraging, however, and with increased capacity in 1925 a decided gain in recovery is anticipated.

Czecho Granulated, its Quality and Production.

By Dr. JAR. DĚDEK, F.C.S.,
Consulting Chemist, Prague.

The enormous support of the British Government to aid the home beet sugar industry has been recently discussed from the technical standpoint, and some have raised the point as to what extent consumption sugar can be made directly from beets. Detrimental statements have often been made from time to time against the manufacture of white sugar directly from beets in general.

The production of granulated in Czecho-Slovakia this year is estimated to amount to some 900,000–1,000,000 tons. From this quantity about 200,000-250,000 tons are made directly from beets, the rest being produced from washed raw sugars with the aid of bone char or vegetable carbons. Nearly all of the granulated beet sugar directly produced is consumed either in Czecho-Slovakia or exported to southern or eastern countries, the Czecho granulated exported to England thus being practically only refined sugar.

DIRECT PRODUCTION FROM BEETS.

It would, however, be absolutely wrong to conclude from this fact that first-class granulated sugar cannot be made directly from beets. The preponderance of the refined granulated in our exportation to England is due to the historical development of our industry, which for many years has been an export industry. The low quality of raw sugars formerly delivered to the refineries, the crude methods of refining these used (some of our sugar-houses being as old as ninety years), the growing competition of the English market, the demand of the chief consumers for high quality (Adant cubes, etc.) which until now could be made only from highly decolorized refinery liquors—these are the reasons why our export refineries are all equipped with large bone char and vegetable carbon plants.

The increasing demand for granulated sugar, so characteristic of recent years, has compelled our refineries to enlarge, at the expense of their hard sugar production, the departments for granulated, which, therefore, is still made from refinery liquors. On the other hand, there has been created a comparatively new industry consisting of "mixed" factories which work directly from thick-juice to white sugar. The quality of the granulated sugar so produced has attained in Czecho-Slovakia a very high level, the product of most factories competing successfully with the refined product.

CONDITIONS FOR SUCCESSFUL OPERATION.

The manufacture of such a quality of granulated from thick-juice is, however, according to experiences in Czecho-Slovakian factories, dependent on a number of conditions, some of which may be cited as follows:—

The most important one is the high quality of our beets (grown from original Czecho-Slovakian selected seeds, the leading marks being Dobrovice and Zapotil).

In our climate the roots from these seeds contain, when ripe, an average of 18–20 per cent. of sugar, and yield a crop of 0 2–0 4 tons of sugar per acre.

Such beets yield diffusion juices of 90–92° purity, from which thick-juices of 94–96° purity can be obtained High purity is of course one of the first requirements in white sugar manufacture

This condition is maintained by thorough work in the factory, such as double or triple carbonatation with a sufficient quantity of lime, followed by sulphitation, and the filtration of the thin or thick-juice, or better still of both

This treatment decides not only the purity but also the colour of the juices. A minimum colouring of the thick-juices as low as 6° Stammer on 100 sucrose has been attained. Evaporators of course must be of such a design that no appreciable darkening of the juices can develop during the concentration to the thick-juice, rapid circulation and short contact with the heating surface being the characteristic features of the most suitable systems

Experience during recent years has shown that even evaporators working under pressure (for example, the Vincik-Turek and such types) are quite suitable. One of the most interesting natural conditions making possible white sugar manufacture from thick-juice is that colouring matter, contained in the thick-juice, does not enter into the sugar crystal and can thus be easily washed away, leaving a brilliant white crystal This makes it possible to boil a first-class white sugar from thick-juices of 12–16° Stammer, whereas refinery liquors of such colours give sugars of a very poor appearance

But even a brilliant and lightly coloured thick-juice does not necessarily mean a first-class granulated This generally proves the weakest point when raw sugar factories commence to make white

White sugar manufacture is a refining process yielding a finished product, whereas raw sugar is but a raw material Refining takes for granted a certain standard throughout the factory, which is not so easy to acquire Besides, a thorough knowledge of all the details of actual refinery work is necessary One of greatest importance is the operation of graining and boiling to massecuite, which must give a crystal of even size and regular form Boiling with direct steam often engenders caramelization, a very common source of discoloured granulated beet sugar

All other operations—centrifuging, drying, and sifting, can also prove detrimental to the quality of refined sugar if not conducted properly.

USE OF DECOLORIZING CARBON

Recently active carbons have been employed extensively in the manufacture of granulated from beets They are used either on juices or on washed and melted sugars, which are then introduced into the thick-juice

Such a filtration of juices must be accomplished with a relatively high percentage of active carbon, namely, 1 to 2 per cent, so that only revivifiable carbons can be used economically. The influence upon juices is manifested primarily in the change of physical qualities a diminution of viscosity and an increase in surface tension. In practice Norited juices manifest an easier and more regular graining, a higher yield in white sugar in per cent. of turbinated massecuites and a readier and more rapid ripening of molasses sugars, as compared with ordinary operations. Further, the total quantity of boiled massecuites is lowered and thus a marked economy of fuel is attained.

It must be emphasized that white sugars boiled from such juices can by no chemical or physical method be distinguished from the refinery granulated.

Even the surface tension value which has been recommended by **Lindfors**[1] fails. Refined sugars are often boiled with a small amount of vegetable oil in the pan to enable quick boiling without entrainment losses, and in consequence contain traces of this substance sufficient to lower their surface tension, especially pressed tablets in the production of which greasing of the press-tables is indispensable. On the other hand, treatment by active carbons leads to thick-juices, which, in respect of surface-active substances, are absolutely equal to pure sucrose solutions.

Various active carbons have been tried out of late years in Czecho-Slovakia, and of these "Norit" proved most successful. It is interesting to note that even hard sugars (e.g., *pilé*) of high quality have been boiled from Norited thick-juices.

SELECTION OF A BOILING SYSTEM.

Another important point in the manufacture of granulated in regard to which an active carbon again may prove useful, is the system of working. Economy of production, especially in factories working only granulated and molasses, depends largely on the proper choice of a boiling system. Three types of factories can be distinguished: (1) Factories boiling granulated only from the pure thick-juice, and selling their molasses sugars. (2) Factories boiling the thick-juice to raw sugars, washing, melting them, and boiling from these liquors their white sugar—the so-called yellow refineries. (3) A mixed type of both factories which melt the washed molasses sugars, unite the liquor with the thick-juice, and boil the mixture to white sugar. The most useful scheme is determined more by economical than technical considerations.

The second type can be hardly classified as belonging to the granulated beet processes, and is a very expensive one too, sacrificing the most economical side of this kind of work, white sugar production in the first strike already.

From the purely technical point of view the third type is to be preferred. An active carbon process makes it possible to wash molasses sugars within reasonable limits to decolorize the solutions obtained from them, so as to free them from non-sugars interfering with the crystallization of sucrose, so purifying them, and improving the quality of the thick-juice, instead of lowering it.[2] It enables the return of all molasses sugars to the thick-juice in a refined form so as to boil them to white sugar.

Such a scheme makes possible a very economical manufacture of a granulated sugar of the best quality, and may perhaps prove to be the most acceptable plan for the production of consumption granulated of a high quality.

The Pure Cane Molasses Co. have leased a section of land on the James Watt Dock, Greenock, as a receiving and distributing depôt for their molasses (which is mostly used for cattle feeding purposes).

Invert sugar (instead of the more expensive reagents, glycerin and mannitol) is recommended by **G. van B. Gilmour**[3] for the titration of boric acid in the analysis of butters and margarines. In this reaction, combination occurs between the boric acid and the sugar, or polyatomic alcohol, with the formation of a complex having a greater acidity than originally, which acidity can be titrated with reasonable accuracy by standard sodium hydroxide, using phenolphthalein as indicator.[4] This reaction will suggest to the reader a possible method of titrating reducing sugars. Attempts by the author named have, however, proved unsatisfactory, owing to the uncertain end-point when the solution of sugar is added to the mixture of boric acid and sodium hydroxide.

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[1] *I.S.J.*. 1924, 313, 556.

[2] The usual purity tests are of little value to judge the quality of remelts.

[3] *Analyst*, 1924, 49, 576-577. [4] *Ibid.*, 1921, 46, 3-10

Defecation in Cane Sugar Manufacture.[1]

By J. D. BOND,
Ewa Plantation Co., Ewa, Hawaii.

In spite of the long-continued use of lime in defecation, there is still considerable confusion in the literature and among technical men as to the actual mechanism of the process. Thus, DEERR[2] reports a precipitate consisting of coagulated colloids, phosphates, aluminium and ferric oxides, albuminoids, chlorophyll, cane wax, and some of the colouring matter of the juice; whereas GEERLIGS[3] states that gums are not precipitated in slightly alkaline liquids, and HORNE[4] believes the added lime precipitates more and more of the gummy constituents of sap before the juice finally becomes alkaline to phenolphthalein. GEERLIGS[5] further states that the degree of dispersion of the colloidal constituents of the juice is the most important factor in defecation. FARNELL[6] has shown that under optimum conditions the removal of nitrogenous substances, presumably albumin, will increase the purity 0·2 to 0·3 point.

There seems to be some misunderstanding in the use of the term "albuminoids." These are classed under the simple proteins as insoluble in water, salt solutions, acids, or alkalis, and as far as is known no representatives of this class are found in plants.[7] It is probable that albumin is understood, and recent literature has shown this to be true.

There is also confusion in the use of the term "colloids." DEERR evidently uses it as including all dispersed matter in cane juices passing through glass wool. This is certainly a very broad use including, as it does, coarse dispersoids readily visible under the low power of the microscope. We must carefully distinguish between coarse dispersoids and the particles in a true hydrosol and to this end must define limits that may readily be applied in practice. The use of kieselguhr ("Filter-cel") filtering under pressure or vacuum, suggests itself as a convenient limit and is quite comparable with filtration through filter-paper, which is so exceedingly slow as to be prohibitive.

COARSE DISPERSOIDS AND COLLOIDS.

Cane juice was filtered through: (*a*) paper; (*b*) kieselguhr ("Filter-cel"); and (*c*) glass wool, and dialyzed in colloidal sacs in running water, the remaining liquid being evaporated to dryness, and weighed, thus obtaining the non-dialyzable matter left after the three treatments, as reported in the following table:—

Table I.

FILTER.	Juice ° Brix.	Non dialyzing matter Grms per litre
Paper	12·65	0·140
Kieselguhr ("Filter-cel")	12·75	0·163
Glass wool	12·70	2 724

Ultra-filtration, in a sense, can perhaps be demonstrated in the filtering of mixed juice through paper or kieselguhr ("Filter-cel"), but it is not unlikely that here adsorptive effects play a determining part. Work reported later in this paper will further justify this selection of a dividing point between coarse dispersoids and colloids. Following this procedure, it may easily be demonstrated that any well-dialyzed sol from mixed juice, free from molecularly dispersed matter, will show not the slightest agglomeration through very wide ranges of reaction. When alkali-precipitable minerals are present, however, colloids are removed to some extent, owing to the adsorptive effects of precipitates of large surface areas. Furthermore, settlings from mixed juice, treated in the Kopke laboratory centrifugal separator,[1] yielded a turbid run-off, which settled only extremely slowly though the reaction was varied over a wide range. Inspection under the microscope showed that the turbidity was due to coarse dispersoids, characteristic of mixed juice. Addition of a small amount of phosphoric acid was very effective in obtaining a satisfactory settling, the reaction of the liquid remaining alkaline.

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[1] *Industrial and Engineering Chemistry*, 1925, 17, No. 5, 492, *et seq*, here abridged

[2] NOËL DEERR: "Cane Sugar," p. 266.

[3] PRINSEN GEERLIGS: "Cane Sugar and its Manufacture," p. 145.

[4] *Ind. Eng. Chem.*, 1924, 16, 732 [5] *I.S.J.*, 1924, 151 [6] *Ibid*, 1924, 361.

[7] THATCHER: "Chemistry of Plant Life," p 176

FACTORS GOVERNING DEFECATION.

The precipitation of matter from juices occurs as the result of the action of any alkali, whether inorganic, organic, or produced locally by electrolysis. The increase in purity attendant upon this precipitation has not exceeded a maximum value of three points in the writer's work, and the purity increase is in no way related to the purity of the juice. This conclusion can be drawn by inspection of any comprensive data in the literature.

However, the weight of material precipitated must certainly be related to some property of the juice, and since the literature constantly refers to gums and organic non-sugars their influence has been noted in Table II.[2] In these tests the reaction was varied by the use of a calcium saccharate solution. The first series was limed so as to show a reaction of about *pH* 9 after heating to 90°C. and filtering; Series 2, about *pH* 9 in the cold; Series 3, about *pH* 7·5 in the cold. Gums were determined by the method of RUFF and WITHROW;[3] and colloids as already described.

Table II.

					Ash-Free		Precipitate	
Series	Gravity Purity.	Glucose, Grms.	Ash, Grms.	Organic non-sugars, Grms.	Gums, Grms	Colloids, Grms	As weighed, Grms.	Ash-free, Grm.
1	86·18	4·9	2·7	6·2	0·38	0 68	1·37	0·52
2	85·68	4·8	3 2	6·2	0·49	0·45	1·30	0·68
3	85·54	5 9	2·7	5·8	0·37	0 49	0·82	0 51

All figures except those on precipitate are based on 100 gravity solids and refer to raw mixed juice filtered through kieselguhr ("Filter-cel"). It is evident that the weight of precipitate obtained from mixed juice on clarification bears no relation to purity, organic non-sugars, gums, or colloids.

Table III.

		Purities		Per 100 Gravity Solids		
Alkali Used	Filtered through	Apparent.	Gravity.	Colloids. Grms.	Ash. Grms.	No of tests averaged.
$Ca(OH)_2$	Cotton wool	83 5	84·3	2·53	3·4	3
	Kieselguhr ("Filter-cel")	84 3	85·3	0·64	3 3	
	Clarified	84·8	85·0	0·39	3·9	
NaOH	Cotton wool	83·4	84·4	3·75	3·1	4
	Kieselguhr ("Filter-cel")	83·9	84·8	0·78	3·0	
	Clarified	84·4	85·3	0·67	3·8	
NH_4OH	Cotton wool	82·8	83·7	3·13	4·1	3
	Kieselguhr ("Filter-cel")	82·9	83·8	1·10	4·0	
	Clarified	85·1	85·6	0·77	3·5	

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[1] Report of the Committee on Manufacturing Machinery, Hawaiian S.P.A., 1918.

[2] Average figures only are here produced.

[3] *Ind. Eng. Chem.*, 1922, 14, 1131.

Table III gives data on colloids. The juices were treated with the alkali specified so as to show a reaction of about *pH* 9 after heating to 90°C. and filtering The whole juice was then filtered through kieselguhr ("Filter-cel"),

If we consider all the dispersoids passing through cotton wool, about 74 per cent. is removed on filtering through kieselguhr ("Filter-cel") Of the colloids as true hydrosols in kieselguhr ("Filter-cel") filtered juice, only about 25 per cent. is removed. It is evident that coarse dispersoids and colloids are of importance in defecation only as a result of the precipitation produced by the action of alkalis on juices and are not of themselves responsible for this action.

Table IV shows the relation of gums to the defecation process

Table IV

			Per 100 Gravity Solids	
Juice	No of tests averaged	Gravity Purity	Alcohol ppt Grm	Gums Grm
Raw, filtered	21	85·68	0·94	0·52
Clarified	21	86·18	1·21	0·48

It is evident that the defecation process has very little effect on gums. There was no apparent relation between gravity purity and gums, nor was there any relation between the ash of the alcohol precipitate and the ash of the juice The alcohol precipitate from clarified juice showed uniformly a higher ash content than that from raw juice

It has been shown how the precipitate weight varies with added alkali and that ash constitutes a large part of the precipitate The character of this ash is shown in Table V, the procedure for carbonated ash being followed in every case

Table V

(Figures in per cents)

		Ash		Ash of Precipitates from		
	Mixed Juice	Syrup	Molasses	$Ca(OH)_2$	NH_4OH	NaOH
SiO_2	3·67	5·49	7·42	2·87	0·42	0·50
SO_3	20·21	18·66	21·37	0·19	0·15	0·20
P_2O_5	26·90	4·72	2·36	38·65	60·90	47·65
Cl	19·73	16·21	16·33	2·64	0·43	1·79
Al_2O_3, Fe_2O_3	0·40	0·46	0·38	7·66	0·10	0·12
CaO	5·62	24·80	10·30	38·53	10·98	29·96
MgO	12·31	13·24	9·89	6·23	26·16	16·03
Deduct O = Cl	4·45	3·66	3·68	0·60	0·10	0·40
Unburned C, CO_2, alkalis	25·61	20·28	35·63	3·83	0·96	1·84

Inspection of the precipitate ash analysis shows that it is composed chiefly of CaO, P_2O_5, and MgO, and that P_2O_5 as phosphate plays the most important part Magnesium is only of secondary importance. Table VI gives data on CaO and P_2O_5 relations in the precipitate.

Table VI.

(Per 100 gravity solids)

		Precipitate	
Total CaO Grams.	Juice CaO Grams	CaO Gram	P_2O_5 Gram
0·309	0·159	0·150	0·158
0·507	0·247	0·260	0·212
0·754	0·434	0·320	0·222
1·401	0·915	0·486	0·234
1·841	1·281	0·560	0·235
2·156	1·491	0·665	0·236

It is particularly interesting to note the increasing CaO content of the precipitate with P_2O_5 virtually constant. These data represent extremely alkaline conditions such as never obtain in the defecation process.

If phosphates are removed from the juice, a marked change will be noted in Table VII. This may be accomplished in acid solution by the application of the basic acetate separation principle, and by the use of uranium salts. It is extremely difficult, however, under these conditions, to avoid the use of an excess of reagents, and since they precipitate on making the solution alkaline, some precipitation from them may be expected. Filtered juice was used.

Table VII.

Treatment	Weight of Precipitate Untreated Juice. Gram/litre.	Treated Juice. Gram/litre.
Basic acetate, filter, alkaline with NaOH	0·442	0 063
Uranyl nitrate, filter, alkaline with NaOH	0·442	0 049

Hence, the importance of phosphates in the formation of a precipitate is evident. Of 73 laboratory reagents tested as to their effect on boiling juice, those resulting in satisfactory precipitates were barium hydroxide, ferric salts, lead acetates, and uranium salts, all of which precipitate with phosphoric acid under conditions obtaining in boiling juice. Alkali carbonates did not give satisfactory results.

It has been shown that phosphates are the determining factor in defecation in so far as mineral matter is concerned: it remains to show the amount and influence of organic matter. Precipitates were obtained from filtered mixed and last mill juices, using chemically pure milk-of-lime. Results are given in Table VIII.

Table VIII.

Juice.	Per cent ash-free.	Carbon Expressed as: C	CO	$C_6H_{12}O_6$
Mixed	28·7 ..	5·70 ..	20·9 ..	14 3
Last mill .. .	56·2 ..	14·23 ..	52·2 ..	35·6

There is considerable organic matter in these precipitates, but its effect is evidently secondary to that of inorganic matter.

If defecation is essentially an inorganic reaction, or reactions, it should be possible to devise a laboratory scheme of clarification superior to the usual methods. To this end filtered mixed juices (Table IX) were treated with barium hydroxide (to precipitate sulphates and phosphates and increase *pH* values), and with freshly precipitated silver oxide (to precipitate chlorides), followed by a second filtration through kieselguhr ("Filter-cel") after heating.

Table IX.

Juice.	° Brix.	Polarization.	Apparent Purity.
Mixed	13·70 ..	11·87 ..	86·64
Clarified	9·55 ..	8·86 ..	92·77

An excellent clarification was obtained, showing that the part played in defecation by inorganic reactions is at least of considerable importance.

The actual amount of precipitate in defecation is of great importance; if too small, inefficient defecation results; if too great, the filter-presses are overburdened by the large volume of material which must be treated. Defecation, as the writer knows it, is essentially a process for removing coarse dispersoids from juices by the formation of a flocculent precipitate within the juice. This precipitate not only adsorbs colouring and colloid matter, but enmeshes suspended matter and carries it down in settling, as is clearly demonstrated under the microscope. Since the formation of this precipitate is dependent upon the phosphate content of the juice, a low content will, *prima facie*, result in poor defecation. After sufficient precipitate has been formed, very little is gained by additional precipitation, and for this reason the addition of phosphates to juices cannot be justified unless the phosphate content is too low. McALLEP and BOMONTI[1] have shown that for efficient clarification the P_2O_5 content of the juice should not fall below 0·30 to 0·35 grm. per litre.

In Table X are shown relations between liming and volume of settlings, and between liming and the ratio of CaO to P_2O_5. Calculated ratios are taken from Table XI.

Table X.

	CaO · P_2O_5 Ratios						Volumes of Settlings per cent		
No.	*A*	*B*	*C*	*D*	*E*	*F*	*A'*	*B'*	*C'*
1	1·189	1·087	0·986	1 172	1·053	1·050	8	6	3·6
2	1 065	0·967	0·925	1·110	1·067	1 032	11	11	11·6
3	0·889	0·911	0·825	0·992	0·983	0 878*	16	13	18·9
4	0·876	0·802	0·706	0·947	0·931	0·961	17	19	19·8
5	—	0·806	0 666	—	0·921	0·958	22	25	28·8
6	—	—	—	—	—	—	30	26	32·7

* Error

Magnesium in the precipitate shows no relation to volume changes—a fact which direct tests have substantiated, The increasing volume of settlings must be due to changes taking place in the CaO to P_2O_5 relations, as the data in Table X distinctly show.

In Tables XI and XII are given data on the relation of CaO and P_2O_5 in juice and precipitate, *pH* values being estimated by the method of GILLESPIE.[2]

Table XI.

(Figures in grms. per litre.)

	Juice	Precipitate		
pH	CaO	CaO	P_2O_5	MgO
6·9	0 228	0·097	0·081	0·042
7·8	0·179	0·298	0 324	0·058
8·5	0 241	0 396	0 383	0·087
9·2	0·347	0·426	0·388	0·142
9·8	0·441	0 500	0 401	0·175
10 5	0 695	0·521	0·420	0·219

Table XII shows the analysis of clarified juices and precipitates for CaO, P_2O_5, and MgO.

The remarkable fact shown in these tables is that, though lime is added to the juice, its CaO content may actually decrease up to a reaction of about *pH* 8 in the cold. Above this point the CaO content increases rapidly. Thus it is entirely possible to clarify juices with lime and obtain a clear juice of lower CaO content than originally present.

Table XII.

(Figures in grms. per litre.)

	Juice			Precipitate		
pH	CaO	P_2O_5	MgO	CaO	P_2O_5	MgO
Raw	0·154	0·384	0 406	—	—	—
7·2	0·249	0·191	0·356	0·185	0·193	0·050
8·25	0·251	0·093	0·325	0·289	0·292	0·081
9·1	0·259	0·087	0·318	0·316	0·297	0·088
9·25	0·311	0·084	0·314	0·317	0·301	0·091

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[1] *I.S.J.*, 1924, 142.

[2] CLARKE: "The Determination of Hydrogen Ions." p. 129.

Table XIII gives data on a juice the reaction of which was increased in small steps.

Table XIII.

(Figures in grms. per litre)

pH	CaO	P_2O_5	MgO
		JUICE.	
Raw	0·180	0·357	0·392
7·0	0·252	0·188	0·355
7·1	0·249	0 180	0·360
7·2	0 239	0·125	0·355
7·3	0·230	0·115	0·348
7·6	0·241	0·099	0·346
7·7	0 241	0·099	0 341
7·8	0 258	0·089	0·341
8·0	0·259	0·062	0·339
8·2	0 267	0·060	0·341

Table XIV shows data on cold juices, clarified without heating.

Table XIV.

(Figures in grms. per litre.)

	JUICE		PRECIPITATE	
pH	CaO	P_2O_5	CaO	P_2O_5
Raw	0·225	0·427	—	—
6·9	0 322	0·381	0·031	0·038
7 0	0·333	0 356	0·060	0 083
7·1	0 349	0·328	0·067	0·099
7·4	0·291	0·211	0·221	0 198
7·8	0 239	0 102	0·351	0·325
8·4	0·219	0·019	0 428	0·390
9·0	0·259	0·008	0·522	0·416

It is impossible to correlate these data to existing laws of equilibrium, and it is evident that there are disturbing influences. The ratio of CaO to P_2O_5 in the precipitates is not constant, but increases as the reaction is increased as shown in Table X. From Table VI the ratios are in the order, 1·06, 0·86, 0·66, 0·48, 0·42, 0·35. This ratio for the secondary calcium phosphate is 1·127 and for the tertiary salt, 0·83. Uncombined CaO can exist, then, only in solid solution in the precipitate. These relations of CaO to P_2O_5 in dilute solutions have been noted in the literature.[1]

The influence of organic acids is shown in Table XV. Solutions of monosodium phosphate containing 0·74 grm. P_2O_5 per litre and acid as indicated were brought up to a reaction of *pH* 8·0, while boiling, with a normal solution of calcium saccharate. The analyses refer to the filtrate.

Table XV.

(Figures in grms. per litre.)

CITRIC		TARTARIC		HYDROCHLORIC.	
Acid.	CaO.	Acid.	CaO.	C.c. of *N*/1.	CaO.
0 70	0·057	0·00	0·000	4	0
1·40	0·169	0·75	0·020	8	0
2·10	0·320	1·50	0·211	12	0
—	—	2·25	0·372	—	—

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[1] ROSCOE and SCHLORLEMMER, "Treatise on Chemistry," Vol. II, p. 557.

The influence of organic acids is thus quite evident and contrast sharply with mineral acid. It has long been known that the precipitation of salts soluble with moderate difficulty, such as phosphates, is rendered more difficult by complexions of organic oxygen derivatives.[1]

Data on the buffer action of juice are given in Table XVI. The boiling juice shows marked buffer action in the range 6·8 to 7·1, though distinct buffer action is shown over the entire range. This buffer action is due primarily to phosphates, influenced, however, by organic acids and especially by adsorbed substances.

Table XVI.

Cc $N/1$ Saccharate per litre.	*pH* Values Cold.		Cc $N/1$ Saccharate per litre	*pH* Values. Cold.	
		Hot.			Hot.
1	6·0	—	10	7·5	6·9
2	6·4	6·2	11	7·7	7·1
3	6·5	6·4	12	7·9	7·2
4	6·6	6·6	13	8·0	7·4
5	6·9	6·7	14	8·1	7·8
6	7·0	6·8	15	8·3	8·0
7	7·1	6·8	16	8·6	8·2
8	7·3	6·8	17	9·0	8·6
9	7·4	6·9			

Table XVII shows the relation of *pH* values in the various steps in clarification in the factory. The data cover a period of 10 hours, sampling every 15 mins. Excellent clarification was obtained.

Table XVII.

	Raw-limed Juice	Clarified Juice	Syrup
No tests averaged	40	79	40
pH values	8·42	7·99	7·82

It is thus evident that the actions taking place in defecation are influenced by so many varying factors that their formulation will be difficult indeed, if not impossible.

The Chancellor of the Exchequer stated[2] that there are 138 distilleries in the U.K. and Ireland, 118 producing spirit for beverage only, five for industrial purposes only, and the remainder for both.

A plant for the production of alcohol from cellulose has been put into operation by the Kocher Co., Inc., of Los Angeles, in which the raw material (wood-waste) is saturated by HCl gas in screw conveyors, and is converted into glucose in a pressure vessel at 2 atmos. and 60° C. This liquid after neutralization may be fermented, or it may be evaporated, and the product used as a cattle feed. A yield of 65-70 gallons of ethyl alcohol per ton of sawdust is said to be obtainable by this process, and 80 per cent. of the "glucose" produced by the conversion is fermentable.

According to *Commerce Reports*, there have been large demands in the U.S.A. for molasses during the past year in the manufacture of industrial alcohol. Up to a few years ago most of the alcohol was derived from grain, especially corn. Within recent years, however, the cheap blackstrap of Cuba has come to be the principal raw material for this purpose. Blackstrap is also used to a limited extent in the manufacture of foodstuffs and for reworking into table syrup. As an index of the increasing importance of the U.S. alcohol industry, it is reported that in the fiscal year ended June 30th, 1907, there were eight denaturing plants in the United States, which produced 1,780,276 wine gallons. The number rose to 44 plants manufacturing 55,679,597 gallons in 1917, and to 83 plants producing 67,687,295 gallons in 1923.

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[1] Stieglitz, "Qualitative Chemical Analysis," Vol. I, p. 239. [2] On May 5th, 1925.

Recent Work in Cane Agriculture.

REPORT OF THE COMMITTEE ON EXPERIMENT STATION. *H. F. Hungerford. Philippine Sugar Association Convention, Manila, 1924.*

It is held by this Committee that the first and most important duty of the Association is to found an Experiment Station. The subject is considered from the widest point of view and, naturally, the Committee turns its eyes to the work of Hawaii in this direction as one of the most striking examples of science applied to industry. The function of such a station or series of stations should be, as there, to make a study of commercial fertilizers; the provision and uses of irrigation water; the production and testing of varieties of cane suited to different local conditions; the control of pests and diseases, where possible by natural enemies; the thorough study of injurious forms in other countries and the institution of safeguards against their introduction by proper quarantine arrangements; the development of original methods of agriculture suited to the peculiar local conditions; and a thorough engineering and chemical control of the factories; in brief, to make a profound study of fundamental principles by means of a central organization, supported and controlled by the industry itself, whose main object must be to increase the output of sugar per unit of labour and land, and if possible to reduce the cost of production, at the same time safeguarding the fields from the outbreak of serious epidemics. For such work it is primarily necessary to correlate labour and capital with soil and climate and the other factors mentioned above.

As regards the fundamental factors of soil and climate, the work done in other countries will chiefly be of use as indicating the best methods to be adopted. SIR JOHN RUSSELL is quoted as laying it down that the relation of soil to plant growth is both intrinsic and extrinsic, that is: it not only depends on the actual composition of the soil but also on the climate and topography. Thus the water supply, which at any time is a balance of gains and losses, depends for the former on the local rainfall, the drainage from higher lands, and the surface tension of the subsoil; and for the latter on subsoil drainage, and surface evaporation which again is influenced by temperature, exposure, velocity of wind and method of cultivation. This opens up a wide study, as to the nature of the soil particles, the amount and distribution of the rainfall, the local topography, shade, aspect and so on, the depth of the soil and nature of the subsoil. Comparatively little work along these lines has thus far been done in the Philippines. On one plantation (Mindoro Sugar Company), for the past seven years the classes of soil have been studied in relation to the yield of sugar obtained from them per acre; in Negros many soil analyses, physical and chemical, were collected by WALKER some years ago in the chief sugar tracts of that island; and in Luzon similar studies have been made by COX and ARGUELLE, but in both cases the number of samples were too small for general deductions to be made. The Committee considers that such studies should be greatly extended, if possible to every estate, with maps and records of annual yields, treatment of the fields, distribution of the rainfall, and so on. The burning of trash should receive special attention because of the prevailing need of humus in the soil; and connected with this the washing out of salts, especially lime. As contrasted with Hawaii, where there is none too much land and such experiments are difficult, there is abundant scope in the Philippines for studies to be made on the renovation of worked out soils by introducing rotations, green manuring, etc., and on the maintenance of the fertility of newly opened tracts.

Cultivation methods can only be stereotyped alongside of studies on soil and climate as indicated above. Whatever be the cause, there are great divergences in agricultural practice; and these should be studied by the officers of the Experiment Station, so as to correlate them with the local conditions of soil, climate and environment, and by this means to throw light on their soundness and the possibility of their improvement. Such improvements should aim (quoting **Russell** again) at increasing the water supply by deepening the soil, breaking the pan and enriching the deeper layers, supplying air to the soil by drainage, building up the soil into compound particles, adding where necessary lime and organic matter, and increasing the food supplies by the addition of fertilizers and green manuring or by feeding cake on the land.

As to fertilizers, work on these has been actively carried on for the past three or fours years, at first by the Philippine Sugar Centrals Agency in co-operation with the Bureau of Science, and now being continued by the Philippine Sugar Association. Some of the results of this work are summarized in tables, and are considered from the economic point of view, especially as to whether the increased yield of sugar obtained has justified the increased expenditure incurred. As might be expected the greatest deficiency in the soils proves to be in nitrogen, but to all appearance in the majority of the soils the canes cannot profitably use more than 250 kg. of ammonia sulphate. The greatest success has been obtained in certain good lands in Silay, where an increase of 100 *piculs*[1] of sugar was obtained from an expenditure of 85 pesos per hectare; and this would materially reduce the cost of production. In heavy clays if poorly drained the increase was as low as 23 piculs sugar; and this increase would cost the farmer 3 70 pesos per picul, a figure considerably in excess of that incurred by cultivating unmanured land. Excluding the Silay lands referred to above, the general average of the experiments has shown an increase of about 42 piculs per hectare at a cost of 2 pesos per picul of sugar, which is about equal to the cost of cultivating unfertilized land. Unless the price of fertilizers go down, it is thus necessary to look in other directions for reducing the cost of production; it should be noted however that in the circumstances detailed above less land has to be cultivated for the resulting amount of sugar, and on the other hand a greater capital expenditure is involved. The general conclusions of the Committee appear to be that, with greater knowledge of the soil conditions, whether physical, chemical, biological or toxic, it is possible that there may be a great future for the application of fertilizers. And it must be remembered that plot experiments cannot solve all problems in connexion with plant growth, i.e., the effect of lime, the results of manuring with ammonium sulphate, the accumulation of aluminium salts, and other matters which have to be dealt with in the healthy growth of the sugar cane.

The vital need of the Philippine sugar industry is to lower the cost of the picul of sugar, and one method remains which will not increase the capital outlay, namely: the selection of the proper cane to grow in each type of soil and set of environmental conditions. Experiments thus far conducted tend to show that the varieties experimented with do show preferences, whether Cebu Purple, Luzon White, Negros Purple, Pampanga Purple, Badila, H 109, or what not, as to class of soil. But this work needs a great extension in the plantations, and the services of a plant breeder wholly for sugar cane are urgently needed. It must also be remembered that the unfavourable results obtained with new arrivals may sometimes be due to the impoverished conditions of the seed cane after a long journey; and it is absolutely necessary to cultivate such forms for a series of seasons, both as plant canes and ratoons and in varying conditions as well, before being able to determine their value. In the Philippines it is pointed out that there are at present only about half a dozen cane varieties being grown on an extensive scale while in Hawaii there are about thirty; and this in spite of the fact that some 50-60 varieties are available in the islands, most of which have not as yet had anything like a satisfactory trial.

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[1] The *picul* in the Malay States = 60 48 kg , the Philippine *peso* = 2·59 francs; the hectare = 2·47 acres.

The position as regards pests and diseases is similar. A number of scattered observations have been made and it is well known that mosaic, Fiji disease, smut and other diseases are prevalent and are being fought against. But the problem of cane disease is sufficiently important for the Philippine Sugar Association to have its own plant pathologist. And the same may be remarked about an entomologist, since there has not as yet been any proper survey of the pests in the cane fields, although a good many have been noted.

Perhaps the most interesting part of this Report is that dealing with the organization of the proposed Experiment Station. A careful survey is first made of the scientific specialists in the islands who in any way concern themselves with the study of the sugar cane, whether in the Department of Agriculture and Natural Resources, the College of Agriculture or the Bureaus of Agriculture and Science. Practically none of these can give undivided attention to one crop, and those in the College of Agriculture are of course chiefly engaged in teaching and have, so to speak, to do their own research almost by stealth. The comparison is again made with Hawaii, a country where sugar cane is by far the most important crop, although a certain small amount of attention is devoted to pineapples, while in the Philippines there are at least half a dozen major crops to divide agricultural research, and many others of a minor nature. In Hawaii there is the following scientific staff: "one director, one consulting entomologist, two entomologists, four assistant entomologists, one sugar technologist, one assistant sugar technologist, one technical chemist, one chemist, eight assistant chemists, one agriculturist, one associate agriculturist, seven assistant agriculturists, and one plant pathologist. In addition there are one illustrator, one chief clerk, one librarian, a botanist, two forest supervisors and one superintendent of nurseries. Such a personnel in the Philippines would cost not less than 300,000 pesos to maintain, but the Hawaiian Planters' Association have not hesitated to meet the expense in keeping such a big force of experts, as they have more than justified the existence of the station . . . ."

The Committee is emphatic that no effort should be spared in obtaining a suitable director in the first instance, "the most experienced and thoroughly trained sugar investigator in the world . . . . a tried sugar technologist or at least an agronomist familiar with sugar through long experience in the tropics." The actual details of staff and location might well be left to him, but it is considered that the least staff that should be added to the present force employed by the Association would consist of a cane breeder, soil technologist, plant pathologist and entomologist, as without these the Experiment Station could not well be started. The Committee is of the opinion that 50,000 pesos should be ample to start and maintain the station during the first year.

SUGAR CANE WIREWORM (*Simodactylus cinnamoneus*). *Agricultural Report No. 1. R. Veitch. Entomologist, Colonial Sugar Refining Co. December, 1916.*

The percentage of germination of the sets in many planted cane fields in Fiji has been noted to be often extremely disappointing; and in most cases it has not been possible to attribute this to poor seed, dry weather, cold wet soil, and so on. It occurs in every type of soil, and as a matter of experience chiefly in rich alluvial flats where all the conditions give promise of large crops of healthy canes. A study of such fields by the entomologist easily demonstrated that a wireworm was by far and away the most important factor in the case; and not only as diminishing germination, but through weakening the plants in reducing the tonnage of canes and the sugar content in the final crop.

It thus became necessary to determine the amount of damage done, and an exhaustive study was made by VEITCH of an area of 37 acres of newly-planted canes, where no other harmful agency was present and the management was justified in expecting a 40-ton crop of canes. The method adopted was to examine successively sections of 40 sets at regular intervals throughout the field. After these had been dug up, a second series of the same number of sets adjoining the first was similarly studied, and so on until the whole area was thoroughly gone through. By this method it is obvious that details could be obtained of the behaviour of the pest throughout the early stages of growth of the cane. As examples of the results of this study, the following will suffice: 37 of 40 sets dug up showed that the newly emerging roots were being eaten by the wireworms; in another case 99 of the 208 eyes in 40 sets had been eaten out; the sets were immediately attacked at their free ends and attention paid by the worms to the roots and eyes within five days after planting; in a block of 1·4 acres, 46 per cent. of the sets failed to germinate; as many as 16 wireworms were found surrounding one set; in one field the damage amounted to 75 per cent. of the sets planted; the whole area of 37 acres was successfully replanted at a cost of £1 13s. 8d. per acre, and in another case the cost was £2 per acre.

A study of the life history of the pest showed that the egg, pupal and adult (click beetle) stages were passed through in a comparatively short time, while the larva (wireworm) which alone caused damage lived for two or three years feeding voraciously all the time. Judged by laboratory experiments any system of fallowing, which naturally suggested itself, was inapplicable; for the worms were able to live in clean, moist sand without apparent injury for six months: this attempt at starving the larvæ was thus a failure. The question as to the best method of replanting thus became important. Replacing the failures by new sets was not encouraging, for they were immediately surrounded and attacked. Stump planting, that is supplying grown plants, however, proved to be easy and quite satisfactory. In a comparative test of these two methods, it was found that set planting resulted in 46 per cent. of failures, while stump planting gave 100 per cent. successes. The remedies suggested at this early stage of the investigation were as follows: to make provision for supplying by planting additional rows of sets from which to draw in case of need; to increase the relative amount of ratooning as much as possible, thus providing the labour necessary for the proper treatment of the decreased area of plant canes; to adopt clean cultivation and thus keep out the weeds in which the click beetles find shelter; and to do all that is possible to induce rapid growth in the young canes, so as to pass them more quickly through the danger period. The wireworms were found to be extremely active and thus able to get back into the soil in a few seconds, thereby escaping the attention of the mynahs which accounted for so many of the white grubs turned out by the plough; and no parasites of any kind were found upon them.

THE HORNET IN FIJI (*Polistes hebraeus*). *Agricultural Report No. 2. April, 1917. Ibid.*

The author points out that this is not a true hornet, but the form so widely distributed throughout India and the east. It was apparently introduced about the beginning of the century, hypothetically, during its hybernating stage in an immigration ship. Its increase has been extremely rapid in Fiji and it promises to be an unpleasant and permanent addition to the fauna of the sugar cane fields. Naturally, its action is more that of interfering with the labour than damaging the cane directly. The various stages in its life history are described and figured: egg, larva, pupa, adult. In the latter there are males and females. There are two kinds of females, fully developed queens and imperfect workers, and between these there is absolutely no clear line of demarcation, as many intermediates occur. The male is solely concerned with reproduction, and as it does not sting is a minor factor in the problem; it appears at the end of the season and dies before the hibernating period is entered.

The fertilized queens pass through their period of hibernation congregated in masses in out of the way places. In one case the author came across about 3000 of them in an old case in the verandah of his office. The period of inaction lasts for between seven and eight weeks during the colder season, August and September. By the beginning of October the solitary females are busily engaged in nest building. Little skill is shown in the selection of site, as this is reported to be frequently most unsuitable for the heavy nest. The first operation after the site has been fixed upon is the preparation of building material. This consists of fibrous tissue obtained from the bark of the coconut, sugar cane or any reeds, torn up into minute shreds and mixed with a strongly glutinous material; the result being a tough, thin papery substance. For the stalk by which the nest is hung an extra strong material is made with a larger percentage of the cementing substance. At the end of this stalk a few irregular shallow cells are built in each of which an egg is deposited, care being taken to glue it to the side of the cell because of its open hanging position. Around this nucleus the accurately six-sided cells are laid down in concentric rows till about fifty are completed. For all this work, building, laying, feeding, the queen is single-handed. The feeding is rather interesting and reminded the author strongly of that of birds on a nest. On hatching, the grubs are fed on sugary substances obtained from flowers for the first few days, but after that they become carnivorous. All sorts of insects are captured, their horny parts cut off and the rest well mixed and pulped. Then the queens run over the cells, inspecting the open mouths of the grubs of different ages, and popping in a packet where it is needed most. When about 50 cells have been completed, the first brood emerges and the time of stress is over. The eggs hatch in a few days, the larva feeds for from 14–18, and the pupal period adds 15 to 16 more. Then the nest rapidly increases and new layers of cells are added over the older ones; and in a short time the air becomes filled with millions of hornets.

In April laying ceases, and at the end of the month the great proportion of hornets emerging are males, these appearing only at this time. The nests are soon deserted, and the mixed company seek out sheltered places in the fields, emerging for about 4 hours in the middle of the day and swarming round buildings with the object of mating. Then it is noticed that large numbers are dying, and these are found to be chiefly males; in one count, of 275 dead hornets 271 were males.

This description gives a rather alarming picture of the state of the cane fields but, although the insects are undoubtedly often very troublesome and even dangerous, there are mitigating circumstances. During the cutting season, from June to September, there are no hornets in the fields; and in October and November the nests are small and the queens are much too busy with their first broods to attend to the labourers. By December, however, the nests are large and workers are sometimes very severely stung. The worst hornet period, from January to April, is after the cutting season; but the gangs engaged in weeding, cutting back beans or collecting cane seed are often attacked. Where, as in some places, the canes are trashed, it is impossible to enter the fields till labourers clothed with strong canvas suits, gloves and veils have first gone over them to destroy the nests, and this entails considerable expense. But it must be remembered that the hornets, feeding mainly on insects, must destroy vast numbers, many of which are injurious to the sugar cane. As to remedies there are few. Ammonia is kept available and greatly mitigates the pain, and the natives employ large quantities of lime for the same purpose with less certain results. To children and horses the hornets are a constant menace, and a case is quoted of a horse which, being tied to a tree, was attacked and died of suffocation from the hornets settling on his nostrils and causing the air passages to be completely closed up by their stings. As to enemies, thus far only one has been noticed but not certainly determined. In one instance out of 30 nests 27 were found to be raided by this unknown benefactor.

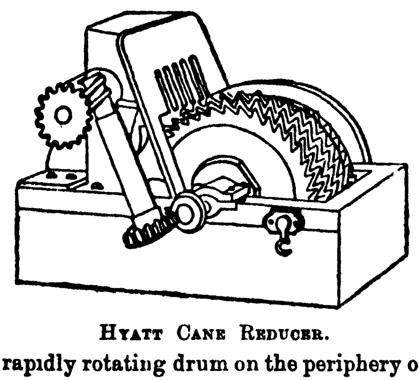
C. A. B.

Simplified Method for the Determination of the Polarization of Bagasse.[1]

By TH. E. R. G. ARNOLD.

The hot method for the determination of the polarization of bagasse, as described in Tervooren and Prinsen Geerligs' work,[2] and as followed generally at the present time in Java, is very weak, being not only unreliable, but complicated as well. Very praiseworthy, therefore, is the recent attempt of Messrs. Nieboer and Ten Bokkel Huinink[3] to find a simpler and more reliable procedure. Seeing that their method of operating has not yet come into use, and that it is still susceptible of improvement, I will endeavour to bring it nearer to the ideal, on paper at any rate, not having had the opportunity of experimenting. It is hoped that the Experiment Stations will take the matter up.

I am in agreement with these gentlemen that the cold digestion method should be the simplest. But in order to apply a reliable cold method of analysis the sample of bagasse from the first mill must be so finely divided that it freely and quantitatively passes a sieve with round perforations 2 mm. in diam. In place of the bagasse chopper now used, I advise a cutting apparatus having rapidly rotating knives. This machine has therefore yet to be devised, and its suitability proved in practice. Noël Deerr[4] mentions in his work several existing laboratory machines for disintegrating cane when examining its sugar content. Of these he recommends the Hyatt cane reducer (see sketch), saying of it that "it consists of a horizontal, rapidly rotating drum on the periphery of which are arranged a series of staggered teeth or 'drunken saws.' This machine rapidly reduces cane in quantity without loss of juice to a finely shredded condition from which the juice is readily extracted."



Hyatt Cane Reducer.

If cane can thus be disintegrated (powdered), probably bagasse can also. Should this reducer meet requirements, then it would be possible to prepare the sample much more easily than is at present the case.

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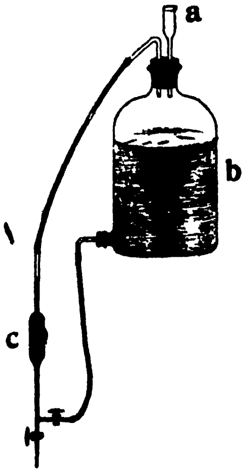
[1] *Archief*, 1925, 33, No. 14 303-307 (here abridged).

[2] "Handboek" Deel 1, 4th edition, 1919, page 134.

[3] *Archief*, 1924, 32, No. 2, 31-34; and 1924, 32, No 2, 34-63 See *I.S.J.*, 1924, 275.

[4] "Cane Sugar," page 513.

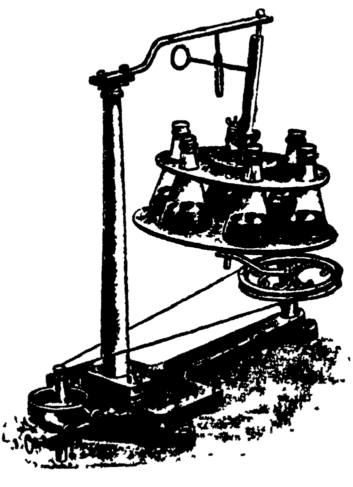
The determination of the polarization itself would take place according to the Sachs le Docte method, as is recommended in the beet sugar industry,[1] modified, however, in the following way: After the sample has passed the reducer and the sieve, it is homogeneously mixed; and 26·048 grms. are weighed out in a counter-poised cylinder. Using a pipette, 186 c.c. of a dilute solution of basic lead acetate[2] are added; and the cylinder closed and placed for a quarter-of-an-hour on the shaking machine (see illustration[3]). At the end of this time, the liquid is poured upon a dry, folded filter over a dry cylinder. The filtrate is polarized in a 400 mm. tube, the figure read giving the polarization of the bagasse.



COMBINED PIPETTE AND BOTTLE.

The pipette which has occurred to me to be as suitable is that described in the work of TERVOOREN and PRINSEN GEERLIGS[4] for the calibration of flasks and the like on the large scale, choice being given to it as compared with Fruhling's pipette by reason of its simplicity, and of its allowing for precipitation of lead carbonate.

The concentration of 0·5 normal was chosen, in order to make the use of a table unnecessary.[5] It is possible, however, that at a concentration of 0·5 normal, and with a quarter-of-an-hour for shaking, the bagasse may not be completely exhausted, thus giving a faulty polarization figure. But this is easy to establish experimentally. If this concentration is too high, then one should experiment during a quarter-of-an-hour with 26·048 grms. of bagasse, to which is added 236 c.c. of liquid, for a final volume of 250 c.c., or 286 for one of 300 c.c., the reading in these cases being multiplied by 1·25 and 1·50 respectively to give the actual polarization.



SHAKING MACHINE.

SPIEGELBERG's simple shaking apparatus (see illustration) appears already to be used in the sugar industry, but in place of the flasks shown it should be equipped with bagasse cylinders[6] provided with properly fitting covers, and coated inside with durable varnish.

If a solution of dextrose in commercial alcohol (100 per cent.) or acetone be poured into benzene, toluene, or xylene, a fairly stable colloidal solution of this sugar is obtained,[7] showing violet, deep-blue, green, shades with a strong opalescence in the complementary colours.

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[1] Frühling-Rössing: "Anleitung," 1919 Edition, page 261.

[2] This dilute solution consists of 70 c c. of ordinary basic lead acetate solution to 1 litre.

[3] Type for power drive is here shown.

[4] *Ibid.*, page 33.

[5] Using 26·048 grms. of bagasse, and making the final volume 200 c.c., this is 200 — 26·048 × 0·55 = 186 to be added.

[6] See FRÜHLING-RÖSSING: "Anleitung"

[7] P. P. VON WEIMARN, *Kolloid-Zeitschrift*, 1924, 36, 118-122, 176-177.

The Canadian Sugar Industry.[1]

Although one of the lesser industries, in respect of the number of plants engaged, the sugar industry in Canada occupies the ninth place in respect of the total value of its production, and the first place in the average value of production per establishment Ontario and Quebec each have two plants engaged in the manufacture of sugar, and British Columbia, New Brunswick and Nova Scotia one plant each, making a total of seven refineries in the Dominion. The Utah-Idaho Sugar Company of Salt Lake City are at the present time erecting at a cost of one million dollars a plant at Raymond, Alberta, with a capacity of 100,000 tons of beets per day. At this refinery all grades of sugar will be manufactured.

The following tables give the principal statistics of the Canadian sugar industry for 1923, and a comparison of the production by classes, quantity and value for the same year. A summary of beet production per acre, yield and value is also shown :—

PRINCIPAL STATISTICS FOR 1923.

Refineries	7
Capital invested	$45,618,182
Employees on salaries	348
Employees on wages—	
Males	1,961
Females	84
Wages	$2,498,555
Cost of fuel	$1,510,367
Miscellaneous expenses	$4,488,744
Cost of materials	$61,817,862
Value of products and by-products	$77,004,026
Value added by manufacture	$15,186,164

COMPARATIVE STATISTICS OF SUGAR PRODUCTION, 1923.

Sugar manufactured, quantity	lbs.	841,978,637
,, ,, value		$78,144,634
Plus sugar imported, quantity	lbs.	17,039,979
,, ,, ,, value		$1,241,491
Less ,, exported, quantity	lbs	119,121,347
,, ,, ,, value		$12,023,173
Sugar available for consumption, quantity	lbs.	739,897,269
,, ,, ,, ,, value		$65,362,952
Per capita consumption, quantity	lb.	81·46
,, ,, value		$7·20

CAPACITY OF CANADIAN REFINERIES.

The average daily capacity of the seven refineries of the Dominion during 1923, as reported to the Bureau, was as follows :—

Beets used	2,499 tons
Raw sugar melted	6,394,580 lbs.
Granulated sugar made	5,233,490 ,,
Soft sugars made	596,086 ,,
Syrups	224,518 ,,

The total exports of molasses from Java for the 13 months May, 1923, to May, 1924, inclusive were 125,972 tons and of this amount India took 69,871 tons, Hong Kong 29,138 tons, and Siam 16,390 tons[2] During the nine months June, 1924, to February, 1925, total exports were 84,255 tons, of which India took 42,216 tons, Hong Kong 16,582 tons and Siam 9,202 tons. A recent feature of the trade is that a considerable demand for molasses has arisen in the U.S. for the manufacture of power alcohol. 6793 tons in January of this year and 2973 tons in February were the quantities shipped from Java to America, and it is reported that contracts for some 50,000 tons of Java molasses to be delivered in shipments of 6000 tons monthly have been entered into by the American firms concerned.

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[1] Dominion Bureau of Statistics Report for 1923.

[2] *Indian Trade Journal.*

The Belgian Beet Sugar Industry in 1924.

(Department of Overseas Trade Report.)

Sugar Beet.—The area of sugar beet under cultivation in Belgium during 1924 was approximately 80,591 hectares, as against 72,340 in 1923. The chief provinces for production were Hainault (22,618 hectares) and Brabant (12,317 hectares). The average yield of roots is estimated at from 27,000 to 30,000 kg. per hectare, or some 2000 more than last year. The sugar content varied from 16 to 17½ per cent. This is rather lower than in 1923, and is attributable to the lack of sunshine and the heavy rains. On the other hand, these weather conditions favoured beet-tops. The foliage was luxuriant and good for forage. Owing to the shortage of the other fodder, excellent prices were obtainable. Experiments are being made with machines for pulling. Labour has been scarce, and certain industrial strikes at harvest time were opportune. Wages per hectare varied from Frs. 350 plus full board, in the Thudinie district, to Frs. 475 to 550 with board and beer in other districts, notably those near the French frontier.

The total yield of raw sugar is estimated at 357,000 metric tons, of which 40 per cent. is, by ministerial decree, to remain in Belgium. The balance can only be exported under licence. Belgian consumption is estimated at 175,000 tons.

Owing to an increased world production (2,300,000 tons increase), prices are not extravagantly high. For November, December, January, February deliveries, they start at Frs. 140 per 1000 kg. of roots, on a basis of 14 per cent. sugar content, and rise Frs. 14 for each additional percentage up to 16 per cent. Over 16 per cent sugar content the rise is Frs. 16 80 per degree. There were 55 sugar factories at work.

Consumption.—The amount of sugar consumed during the 1923-24 campaign amounted to 136,549 tons. It is practically the only article of general consumption which is cheaper than last year. The retail index number (based on April prices in 1914 = 100) in 1924 amounts to 471 as compared with 512 in 1923. This reduction is due to the large output and the important stocks still in hand. These amounted on November 30th to 138,969 tons, including 4497 tons of foreign sugar.

OUTPUT OF REFINERIES AS COMPARED WITH 1913.

YEAR.	TONS.	PER CENT.
1913	130,462	100·0
1923	155,237	118·9
1924	152,239	116 6

Exports and Imports.—Imports of raw cane sugar, which amounted to 39,047 tons for the first nine months of 1924, showed a decrease as compared with 1923 (58,370 tons in the first nine months and 58,814 for twelve months). The main sources of supply were Cuba (19,878 tons), the Dutch Indies (12,453 tons), the Dominican Republic (2816 tons) and Portuguese East Africa (2612 tons).

Exports of refined sugar (56 per cent. of the total production), on the other hand, so far as can be judged by comparison with the 1923 figures (64,106 tons for the first nine months), show an increase in 1924 (84,443 tons for the period ending September 30th). The chief markets were Great Britain (27,600 tons), France (14,000 tons), Switzerland, British India, Persia, Morocco, Mesopotamia and Egypt.

Belgian supplies of lump sugar to the English market have, however, this year dwindled to 10 per cent. of the pre-war figure, and only insignificant quantities have been placed on the French and Spanish markets. On the other hand, these losses in respect of lump sugar have been amply compensated by exports of granulated sugar. Belgian production has also satisfied 75 per cent. of the domestic demand.

The tariff barriers of protectionist countries, such as Czecho-Slovakia, Germany, and, latterly, France, constitute a serious menace to the prosperity of the industry.

Dr. E. F. ARMSTRONG, F.R.S., author of "The Simple Carbohydrates and the Glucosides" and of much valuable work on the chemistry of the sugars, has been appointed Managing Director of British Dyestuffs Corporation, Ltd. (at a salary of £10,000 a year, it was rumoured in the press). It is rare to find one uniting academic, practical, organizing and business ability with such distinction as does Dr. ARMSTRONG.

"Suma-fuge."

A Preparation for preventing Scale Adhesion, also Corrosion in Boilers, Evaporators, etc.

"Suma-fuge" is a preparation which, when painted upon the interior of the heating surfaces of boilers, evaporators, pans, heaters, condensers, piping, etc., leaves a bright, smooth, thin coating of graphite. This smooth surface has a marked effect on the formation of incrustation.

SCALE DETACHABLE AND "PITTING" PREVENTED.

Scale adheres to iron with great tenacity; but, in the case of plates and tubes treated with "Suma-fuge," the scale can usually be detached without difficulty with steel wire brushes, or very readily by lightly tapping with a hammer, the coating of graphite being generally left intact.

For a reason not clearly understood, the nature of the scale forming on such a surface is not the same as on metal. It is much less dense (being sometimes light and soft), and is also much less in quantity.

Another very important advantage is that, graphite being an inert substance, pitting or corrosion due to sugar acids in the boiler feed-water, or to electrolytic action, is entirely avoided.

Engineers often find it of great service to use certain chemicals or boiler fluids for precipitating the salts causing the "hardness" of the water used for steam generation. But "pitting" may occur to a considerable extent, so as to necessitate serious expense for the renewal of plates or tubes. Painting with "Suma-fuge" completely and conveniently avoids any kind of corrosion. It should be applied to the boilers of every sugar factory during the "clean-up" as a wise precaution. Its cost of application is practically nothing, compared with the saving of new boiler plates or tubes.

USES IN THE SUGAR INDUSTRY.

There are no disadvantages whatever attached to the use of "Suma-fuge." It can safely be applied to heating surfaces; it does not contain any oil; and it does not dirty the gauge glass. Furthermore, it does not adversely affect heat transmission, even after the application of several coats.

"Suma-fuge" may be applied to the greatest advantage in the case of boilers (stationary and locomotive), evaporators, vacuum pans, heaters, condensers, piping, etc.; in short, it may be used on any surface which is subject to scaling, corrosion or rusting.

APPLICATION OF "SUMA-FUGE."

All adhering rust or scale should previously be *entirely* removed, after which the "Suma-fuge" is rubbed thoroughly well into the surface under treatment with a suitable stiff brush. (The contents of the packages must be well shaken before pouring out the preparation, which should also be well stirred during the application.) Two, or better three, coats should be given, each being allowed to dry well. Generally, an application lasts throughout the crop. Special brushes can be supplied; and when ordering details should be given of the type of boiler, evaporator, heater, etc. (including the number, diameter, and length of the tubes). "Suma-fuge" is shipped in drums; and an export crate containing ten 1-gallon drums will treat approximately 2750 sq. ft. (in two coats). Full particulars are obtainable from THE SUGAR MANUFACTURERS' SUPPLY CO., LTD., 2, St. Dunstan's Hill, London, E.C. 3.

Publications Received.

Transactions of the First World Power Conference. Vols. I to IV. (Percy L. Humphreys, London). 1925. Price £10 the set of four volumes, £2, index.

These volumes comprise the reports read by a number of prominent power specialists before the Power Conference at Wembley last year. They contain much of general interest to the sugar technologist (though perhaps little of immediate concern), and should be studied by those desiring to keep abreast of modern developments. Vol. I treats of the power resources of the world, II, of water and steam power production; III, of internal combustion engines, power from other sources, power transmission and distribution, gas and fuel and illumination, IV, of power in industry and domestic use, power for electro-chemistry and for transport, and the economic aspects of power resources In Vol. III the most interesting contribution from our point of view is one by Sir CHARLES BEDFORD on "Alcohol as a Source of Power," in which he shows that this is a question that is indissolubly bound up with that of native labour, and in consequence one requiring a far-sighted policy in its development.

Verification of Weights; Testing of Balances; Determination of Densities. Metrology Department; National Physical Laboratory, Teddington, Middlesex 1925

Contents I, Standardization of Mass Verification of weights, general description and accuracy of tests, tolerance tests, variants of test offered, units of mass, ultimate standards of mass, requirements for the construction of weights, the adjustment of weights, the housing of weights, preliminary inspection of weights sent for test, the manipulation and cleaning of weights, marking of approved weights II, The Testing of Balances, And III, the Determination of Densities (solids and liquids) Appendix accuracy of tests, tolerances for weights, specification of tolerances for Westphal balances. Index

Standard Density and Volumetric Tables. United States Bureau of Standards, Circular No. 19 of 1924

Standard tables are given for the density of water at temperatures from 0° to 100°C, density of alcohol of various concentrations at various temperatures, density and lbs per gallon of milk and cream, and of American petroleum oils, temperature corrections to indications of hydrometers in alcohol, sugar, sulphuric acid solutions, and in petroleum oils, relation between degrees A P I and sp gr., capacities of glass vessels from weight of water contained or delivered, and master scales for graduation of hydrometers (alcoholometers)

The Dust Hazard in Industry William E. Gibbs. (Ernest Benn, Ltd, London). 1925. Price 6s.

Contents include Occupational diseases due to dust; explosive dusts, dust explosions, industrial explosions; and dust explosions in mines The author develops his thesis on a theoretical basis, and collates information obtained from the most reliable sources, such as the records of our Home Office, and the Bureau of Mines and of Chemistry, U.S A.

Mineral Resources of the British Empire and Foreign Countries Diatomaceous Earth Imperial Mineral Resources Bureau. (H M. Stationery Office, London). 1925. Price: 6d.

These statistics show (without differentiating grades) the production of kieselguhr, infusorial earth and tripolite in different countries; summary of exports and imports; details of imports and exports (giving quantities and values). In 1922 the production in the U.S. was 39,965 long tons; in Germany, 5123; in Japan, 4617, in France, 4546; in Algeria, 2440, and in North Ireland, 1879. Other countries producing less than 1000 tons are Canada, Australia, Italy, Norway and Sweden.

Brevities.

Power alcohol is being made at the Commonwealth acetate of lime factory, Brisbane, Australia,[1] and a mixture of alcohol (91·5 per cent.), 67·5 parts, benzol, 22·5, ether, 10, with 1 per cent. of wood naphtha and 0·25 per cent. of pyridine, is being supplied to the Australian Post Office. This fuel gives about 75 per cent. of the mileage of petrol (gasoline), and appears to be satisfactory in other respects. A mixture containing alcohol 50, benzol 40, and ether 10 parts is now being tried.

A small handy instrument for the chemist to have in his pocket is the "Magnarule." It serves as a spatula, as a rule (inches and millimetres), as a letter opener, and lastly as a magnifier, since it has at one end a small lens sufficiently strong for the examination of the grain of sugars. A larger and more powerful magnifier, having a lens 40 mm. diam., and a handle which folds across the xylonite frame, so as conveniently to fit the whole in the vest-pocket, is another useful small speciality recently placed on the market.

The Model Sugar Factory of the Imperial College of Tropical Agriculture, Trinidad, started operations on February 25th.[2] Students in the Department of Sugar Technology are working regular hours in the factory and laboratory through a 24 hours' shift carrying out the routine work. It is intended to grind about 2500 tons of cane during about 70 days, manufacturing principally grey crystals, for which there is a ready market locally. Control reports are compiled at intervals, and every effort is made to put things on a commercial basis.

Clarification has been conducted at Ewa (Hawaii) using ammonia instead of lime, or in conjunction with lime. It was found in the laboratory, however, that lime is necessary for the precipitation of the phosphoric acid present in raw juice, but that adjustment to the optimum alkalinity with ammonia was an improvement as regards the removal of magnesium salts. But with this procedure results were disappointing in the factory. While settling was always good, there was a considerably increased amount of mud to be handled in the presses, and altogether the benefits were not found to outweigh the increased costs, that of the ammonia itself being an important item.

J. F. **Snell**[3] has investigated the possibility of utilizing maple sugar "sand" (the deposit obtained during the evaporation of maple sap). He concludes that, although it contains from 65 to 80 per cent. of calcium malate, from which malic acid can be crystallized quite readily, "the prospect of any economic benefit arising from an attempt to conserve this by-product is not at present an encouraging one." He produces evidence showing that it would scarcely appear practicable to buy and collect the sand and transform it into the active acid at a price that would enable it to compete with the synthetic product.

The American President has lately transferred the United States Patent Office from the Department of the Interior to that of Commerce, and Mr. **Hoover**, the Secretary for Commerce, has indicated his intention to take steps to remove as far as possible the unfair treatment of American patentees which rules in certain foreign countries as compared with the privileges of foreigners in the United States. As an example of such discrimination, it is pointed out that whereas some countries require a patentee to manufacture continuously or lose his patent rights, a foreigner can by merely registering a patent prevent manufacture in the United States for 17 years. This American point of view is going to be raised at the international conference for the protection of industrial property, to be held at the Hague next October.

Among new companies recently registered are the following:—British Sugar Manufacturers, Ltd., 314, Lothbury, London, E.C. 2; manufacturers of raw and refined sugar, etc.; nominal capital, £300,000 in £1 shares. Beet Sugar Factories Syndicate, Ltd., 27, Old Jewry, London, E.C. 2; to enter into contracts for, assist, or participate in financial operations of all kinds in connexion with the beet sugar industry, etc.; nominal capital, £100 in £1 shares. Bonnard Carbon Manufacturing Co., Ltd. (Reg. No. 205,924), a private company; manufacturers of and dealers in carbons and carbon substances of all kinds, etc. Nominal capital, £25,300, in 25,000 ordinary shares of £1 each and 6000 deferred shares of 1s. each.

[1] *Chemistry and Industry*, 1823, **44**, No. 19, 487.

[2] *Tropical Agriculture*, 1925, **2**, No. 5, 114.

[3] *J. Soc. Chem. Ind.*, 1925, **44**, No. 13, 140T

A modification of the Hele-Shaw principle of edge filtration, but using centrifugal force has recently been protected.[1] It provides for the filtration of fluids by forcing them by centrifugal force through an annular pile of plain or perforated sheets of paper, in which latter case the filtrate can be drawn off from the perforations. A return stream of compressed air or fluid can be blown in to reverse the flow through the filter for cleaning purposes.

Messrs. EDGAR TRIPP & Co., of Trinidad, reporting at the end of February, stated that reaping operations in the canefields were in full swing throughout Trinidad and the yield of juice was reported as quite satisfactory. Although prices were not as good as at the same date a year previously, it was satisfactory to note that as much as 7,730,783 lbs. of sugar were shipped during February, or an increase of 2,700,000 lbs. over the shipments to the end of February, 1920, the largest on record since 1919.

In a beet sugar factory slicing 10,000 quintals daily, the total steam requirement is 530,000 kg. daily (at 53 kg. per 100 of roots). It is claimed by a correspondent[2] that as the result of the re-construction of the evaporation station so as to include the thermo-compression system, the same factory working under similar conditions will use steam at the rate of 42 kg. per 100 of roots for all its requirements, that is, an economy of 530,000 *minus* 420,000 or 110,000 kg of steam daily, equivalent to 157 quintals of coal daily (using the ratio of 1 : 7). He employs a system of evaporation utilizing turbo-compressors for effecting the compression of the steam,[3] these demanding 280 h.p. in a factory of the dimensions stated above.

The Ministry for Industry and Commerce of Saostat Eireann (Irish Free State) are recommending the grant of prizes to the amount of £1500: (1) To any person who, in their opinion, can demonstrate that it is practicable to produce in Saorstat Eireann alcohol for power purposes at a price and in quantity that would enable it to compete with imported petroleum products or other spirit; and (2) To any person who can demonstrate that it is practicable to produce in Saorstat Eireann an engine using crude alcohol as its sole motive power which is suitable for commercial power requirements, awards being subject to certain conditions. Further particulars are obtainable from DIARMID COFFEY, Secretary, Leinster House, Dublin, Ireland.

During 1923 the number of cane fires occurring in plantations in Java was 538 according to J. J. TICHELAAR,[4] of which 38·6 per cent. were due to malicious intent, 25·3 to accident (e.g., sparks from State locomotives), 15·4 to carelessness (e.g., in smoking), and 3·5 to lightning, the remaining 17·2 per cent. being attributed to unknown causes. In regard to the time at which they broke out, about 60 per cent. were in fields being cut, 30 per cent. previous to cutting, and the remaining 10 per cent. occurred after cutting As preventive measures, it is recommended that trash be removed from the neighbourhood of the roadways; that better attention be paid to the grade of coal used in the locos; that early-ripening varieties of cane be planted in across the fields so as to leave lanes after their cutting; that smoking be prohibited; and that watchmen should patrol the plantations.

"If refined sugar were a chemical commodity rather than a food product, we should have a keener appreciation of the fact that it is one of the cheapest C. P. chemicals. Produced in the U.S. at the rate of nearly 5,000,000 tons per annum, its purity and cheapness are tributes to the efficiency of the chemical engineering operations through which it passes from cane or beet to finished product. To the economist the operation of a basic industry of this character must prove stimulating and suggestive. Whatever may be the objection to centralized control, the factor of cheap production in consequence of the application of the results of intensive research, possible only when adequate funds are available, cannot be overestimated. In this particular instance, consumers have had the full benefit of business initiative and the scientific control of operations, and a low price for sugar is the result."[5]

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[1] U K Patent, 227,890

[2] JOSEF HREBICEK, of Olmutz-Hodolein, Czecho-Slovakia.

[3] Patents pending on such thermo-compression evaporators.

[4] *Archief*, 1924, 32, 613-622.

[5] Extracted from a leader on Crockett (Cal.) Refinery, headed "Sugar as a C.P. Chemical" in *Chemical and Metallurgical Engineering*, 1925, 32, No, 9, 348. [C.P. indicates chemically pure]

Review of Current Technical Literature.[1]

SPECIFICATION FOR LIME FOR USE IN SUGAR MANUFACTURE (AND METHOD OF ANALYSIS OF THE SAME). *M. J. Proffitt. Circular of the Bureau of Standards, No. 207, Department of Commerce,*[2] *Washington, D. C., U.S A.*

Lime for use in the sugar industry requires to be of the purest grade obtainable economically. Lump quicklime and hydrated lime are the grades that are used for the treatment of juices or syrups; whilst lime powder of a fineness that 98 per cent. of it passes through a 200-mesh sieve is required for the Steffen process of precipitating sugar (as tricalcium saccharate) in beet sugar manufacture. According to this specification based on a draft originally prepared by the author (and finally approved by the Hawaiian Sugar Planters' Association) lime products shall meet the following requirements as to chemical composition when the sample is taken at the point of delivery and when the analysis is calculated to a non-volatile basis:

	Lime soluble in sugar solution, minimum per cent.	Magnesium oxide, maximum per cent	Loss on ignition, maximum per cent
Quicklime for defecation, etc	85	3	5
Hydrated lime	85	3	—
Lime powder	90	3	2
Quicklime for Steffen process	90	3	2
Limestone[3] for Steffen process	90	3	—
Limestone for other purposes	85	3	--

Some directions are given regarding sampling, and an outline is stated for the chemical analysis of the product. "Lime soluble in sugar" is determined on material ground to pass a 100-mesh sieve, 5 grms. being placed in a 200 c.c. flask with 75 to 90 c c. of freshly boiled distilled water, boiled gently for three mins., cooled to room temperature, and a solution added of 40-45 grms of white granulated sugar completely dissolved in 40 c.c. of hot freshly boiled distilled water; after shaking vigorously with a rotary motion of the flask, keeping the lime in suspension for 30 mins., the liquid is filled to the mark, mixed and filtered, rejecting the first runnings. Lastly, 100 c.c of the filtrate are pipetted off and titrated with 1·785 normal nitric acid (1 c.c. = 0·050 grm. CaO), using phenolphthalein as indicator; the cubic centimetres of acid used, multiplied by 2, equalling the percentage of sugar-soluble lime in the sample as tested Magnesia is determined in the usual manner, the other determinations being the loss on ignition, and the fineness of hydrated lime and lime powder (per cent. passing through a 200-mesh sieve).

HEAT TRANSMISSION IN JACKETED VESSELS. *H. L. Olin, B. S. Southwick, and H. M. Prince. Chemical and Metallurgical Engineering, 1925, 32, No. 9, 370-372.*

Problems of the flow of heat are intimately concerned with: (1) the constructional material; (2) the condition of the heating surfaces; (3) the density and viscosity of the solution under treatment; (4) the temperature gradient, and (5) the velocity of convection currents Two series of tests made by the authors[4] more particularly illustrate the second factor using a cast-iron vessel of ¼ in. thick walls, lined with welded sheet lead of ⅛ in. thick. This lining much decreased the normal heat transfer of the vessel, since, in addition to the two metal walls of cast-iron and lead having conductivities of 864 and 1920 respectively, there are three gas and or liquid films to retard the flow of heat. Although the film of air between the lead and iron is very thin, it has a conductivity of only 0·0005 that of the cast-iron, these conditions leading to this vessel showing up very poorly in the tests, whilst the lead took on a coating of scale, a further disturbing factor.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] Copies of this Specification are procurable from the Superintendent of Documents, Government Printing Office, D C., U S A., at 5 cents per copy.

[3] That is, limestone calcined before analysis

[4] Department of Chemistry, State University of Iowa, U S.A.

Similar experiments were carried out with a jacketed copper vessel, made of ⅛ in. metal; and at once two characteristics became apparent: viz., that heat transmission was so rapid as to make high steam pressure (used in the previous tests) unnecessary; and that the temperature gradient exercised a marked influence on the coefficient. Later, it also became apparent how the cleanness of the heating surface was a controlling factor of the first rank. This was shown by two experiments in the first of which the heating surface was covered with a film of oxide that had accumulated undisturbed since the manufacture of the vessel some years previously, whilst in the second the same kettle was used after it had been cleaned with nitric acid and kept clean by polishing. It is concluded that for general application a suitable formula for calculation of heat transmission must correlate film conductivity with the affecting factors of convection, shape and condition of surface, thermal conductivity, heat capacity, viscosity and coefficient of expansion of the liquid, temperature gradient. A special equation has to be found for each problem.

THEORY OF THE ACTION OF ACTIVE (DECOLORIZING) CARBONS. *W. Mecklenburg*

Zeitschrift für angewandte Chemie, 1924, 37, 873-877.

Its action is considered to depend, not only on the adsorption due to the large superficial area when applied in a fine powder, but also upon condensation within the capillaries. Indeed, the widely different behaviour of different activated carbons is not difficult to understand when it is considered that their properties depend upon the magnitude (per unit mass) of their surface area and of the volume of the capillaries, the cross-sectional area of the capillaries, the size of the particles, the chemical nature of the exposed surface, the nature of the substance to be adsorbed or condensed, and the presence of other substances.

PREPARATION OF FEHLING'S SOLUTION FOR THE VOLUMETRIC DETERMINATION OF REDUCING SUGARS. *J. Hy. Lane and Lewis Eynon.*

Journal of the Society of Chemical Industry, 1925, 44, No. 14, 150-152T.

The precision of the volumetric method of determining reducing sugars (recently described by the authors[1] in which methylene blue is used as an internal indicator) is such as to bring to light differences in the copper content of Fehling's solution made up from different samples of "pure" copper sulphate. They have therefore thought it advisable to ascertain the extent of this variation under ordinary conditions, to which end a number of samples of copper sulphate were purchased from dealers of repute, these being sold as "pure cryst.," "recryst.," "puriss." or "analytical reagent." In these they determined the Cu electrolytically, whilst from each a quantity of Fehling's solution was prepared, and its titre ascertained by their standard procedure against an invert sugar containing 0·5 grm. per 100 c.c. A copper content ranging from 99·74 down to 98·41 per cent. of that corresponding with the formula $CuSO_4\ 5H_2O$ was found, the "invert factor" (mgrms. of invert sugar for 25 c.c. of Fehling's solution) of course showing corresponding variations. In most cases the difference in the copper content is due, not so much to the presence of impurities, but almost entirely to the presence of water in excess of that corresponding with the formula. Now, if, the tables compiled by the authors for the calculation of results obtained by their method be used, errors due to the irregularity indicated amounting to at least 0·7 per cent. of the amount of sugar determined may arise, whereas the experimental error of the process itself is not more than 0·2 per cent. Fortunately there is a simple means of avoiding discrepancies from this source, namely by checking the titre of the Fehling's solution made up from any sample of copper sulphate, by titrating 25 c.c. of it with a solution of invert sugar containing 0·5 grm. per 100 c.c., operating by the method already described by the authors,[2] when 24·8 c.c. of the sugar solution, corresponding to a factor of 1240 mgrms. of invert sugar should be found. If a different value is obtained, then it is a simple matter to make the necessary small adjustment to the copper solution by adding copper sulphate or water, as the case demands.

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[1] *I.S.J.*, 1923, 143, 305.

[2] *I.S.J.*, 1923, 32.

Review of Current Technical Literature.

ADVANTAGES OF DR. HORNE'S DRY BASIC LEAD ACETATE FOR CLARIFICATION IN THE POLARIZATION OF SUGAR PRODUCTS.

W. D. Horne. *Communication to this Journal, April, 1925.*

Dr. W. D. HORNE, about 12 months ago, devised a method of clarifying solutions of sugar products (massecuites, raw sugars, molasses, etc.) which is now recognized to possess great advantages in respect of accuracy and speed over the ordinary procedure involving the use of a *solution* of basic lead acetate It consists in treating the sugar solution with *dry* basic lead acetate (anhydrous lead subacetate), the procedure being as follows[1] :—The normal weight of sugar (26·048, 26·00, or 16·29 grms.) is dissolved in a 100 c.c. flask, and made up to the mark without defecation. The dry lead powder is then sprinkled in gradually while mixing until the impurities are no longer precipitated, after which the liquid is filtered, and polarized as usual. In this method of working, the precipitate is formed outside of the 100 c.c. and therefore does not modify the concentration of the liquid, the elimination of this error which occurs in the ordinary procedure of using *liquid* basic lead acetate thus being ensured. In determining the purity of a sugar product, the Brix is taken of the normal weight solution, Horne's "dry lead" added until no more precipitate is formed, and the solution filtered and polarized directly. This short method of working with the dry clarifier, instead of with a solution of it, enables five tests to be made in the time usually required to make three. Horne's method has been adopted by the Association of Agricultural Chemists, and by the International Commission for Uniform Methods of Sugar Analysis, after its accuracy had been carefully established by different chemists,[2] and has now been adopted in a large number of sugar factory laboratories.

SODIUM HYDROSULPHITE ("BLANKIT") AS A DANGEROUS MATERIAL IN TRANSPORT.

Report for 1924 of the Chief Inspector of the U.S. Bureau for the Safe Transportation of Explosives and other Dangerous Articles.

A fire occurred in the rail transport of sodium hydrosulphite, having broken out at Harismus Cove, U.S.A., on May 9th, 1924, and although this does not appear to have been a serious mishap, the dangerous nature of the goods unless properly and sufficiently packed is nevertheless shown. It appears that water had obtained access to the chemical, whereupon a considerable amount of heat had developed. That this heat was sufficient to cause a fire was demonstrated in the laboratory of the Bureau by pouring 50 c.c. of water down a glass tube reaching to the bottom of a tin containing 8 lbs. of the chemical, when the temperature of 250°C. was reached in about 12 hours. In the case of the fire under investigation it was reported that a number of the cans in which the hydrosulphite was packed had become broken or punctured, and some had become wet. In the U.S. this product is packed by one firm making it in corrugated sheet-iron drums and by another in wood veneer drums with a tin lining. In future hydrosulphite will be classed in the U.S. as dangerous for railroad and steamship transport.[3]

PROGRESS AND POSSIBILITIES OF THE STREAM-LINE FILTER.

Jos. A. Picard. *The Industrial Chemist, 1924, 1, No. 3, 124-126.*

Further information[4] regarding the Hele-Shaw filter is presented, a description being given also of a rotary apparatus with suction filtering members operated by vacuum. In construction, the filtering leaves do not differ very much from the filter-press cakes, but side members are here necessary and vacuum is applied to the filtrate drainage holes through the filtrate delivery channel, instead of applying pressure to the prefilt in contact with the outer surface. In such a machine the advantages of stream-line filtration are really experienced to the full, for we have here: (*a*) Continuous working; (*b*) Very high capacity per sq. ft. of filtering surface; and (*c*) Production of cakes exceptionally high in solid and low in moisture The capacity per sq. ft. of the stream-line filter is unapproachable as it is the result of the essential properties of the medium, which not only produces bright filtrates absolutely from the commencement, but makes possible working with cakes of exceptional thinness. The rate of filtration for all filters depends almost entirely on the thickness of cake existing at the moment upon the filtering surface. Even with a free filtering material the rate of filtration will drop from, say, 200 gallons per sq. ft. per hour to 20 gallons during the building of a cake $\frac{1}{32}$ in. thick, and for a cake $\frac{1}{8}$ in. thick the rate will be down to 5 gallons or less. High outputs are consequently dependent on dealing with the thinnest possible cakes, which is just what the stream-line filter does with the greatest success. Its close, rigid, and smooth surface permits not the smallest particle of solid to pass and sully the filtrate, and enables the thinnest cakes to be removed completely and easily. Beyond this, the filter possesses an advantage which could not have been foreseen—the cake which it delivers is definitely much drier and higher in solid than corresponding material obtained in filters employing cloth. Frequently, the water content is found to be well under half the usual figure.

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[1] *J. Amer Chem. Soc*, 26, 186 See also *I.S J.*, 1920, 174.

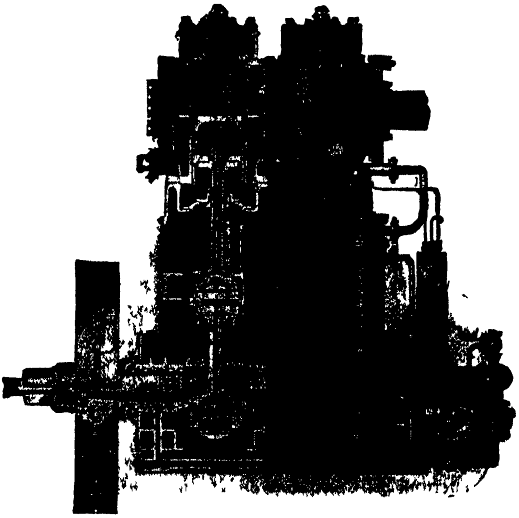
[2] Horne's "dry lead" clarifier is stocked by THE SUGAR MANUFACTURERS' SUPPLY CO., Ltd, 2, St. Dunstan's Hill, London, E.C 3, and is sold in 1, 5, and 10 lb. bottles.

[3] Sodium hydrosulphite is not classed as dangerous in England It is packed for export in tins, which are again packed in over-cases, and this appears to form an adequate packing

[4] *I.S.J.*, 1923, 546, 628 1925, 162.

SOLID INJECTION DIESEL OIL ENGINES. *Anon. Communication from the Worthington Pump and Machinery Corporation, May, 1925.*

The following remarks are based on a lecture on "Engines for Ice Plants" recently delivered by one of the most eminent engineers in the United States, Dr. CHAS. E. LUCKE, who is Dean of the Engineering School at Columbia University, U.S.A., and who also acts in the capacity of Consulting Engineer for the Worthington Pump and Machinery Corporation on Internal Combustion Engine Practice. Dr. LUCKE traced the history of the development of internal combustion engines down through the practice that had heretofore prevailed in Europe to a point where the enormous production of gasoline had thrown on the market in the United States great quantities of residuums and heavy oils, for the use of which there was only a limited outlet. To this latter circumstance he attributed the unprecedented stride that in recent years had been made in the United States towards the development of what may be termed an American type of Diesel engine, the motive being to produce a simplified form of engine that will ensure the same degree of dependability in utilizing these heavy fuel oils that had been already obtained by the use of the American built gasoline engines on the lighter oils. The Doctor cited the fact that the far-sightedness and courage involved in this American practice had attracted the attention of engineers and manufacturers all over the world, and he closed his remarks as follows:—"This solid injection Diesel engine represents to-day the most highly-developed combination of good engine qualities for medium-sized power units that has ever been known. Nothing ever has had such simplicity coupled with ability to burn fuel oils and with so little attendance for generating power in self-contained independent plants. Considering all these different angles of a period of progress: the simplification of ice making with



the increased demand for ice; the simplification of the highly efficient Diesel oil engine represented by its latest solid injection form, with the increased availability of oil fuel forced by the growth of the automobile, there seems to be nothing more natural and proper than to combine these two and to operate the ice-making plant by the solid injection oil engine. While there may be and will be exceptional cases where electric power is extremely cheap and its supply reliable, and where the same may be said of coal and its handling labour, it certainly does seem as if these are to be really exceptions and not the rule, and that there is nothing so well worth while for the members of this association to thoroughly investigate as the solid injection oil engine, not merely for new installations, but even to replace present steam equipment.

Determination of the Sugar Content of Beet Carbonatation Scums. (*A*) *W. Paar and G. Doffmüller. Vereins-Zeitschrift, 1925, No. 821, 82-96.* (*B*) *Adolf Traegel. Ibid, 1925, 145-155.*

(*A*) In Ost's method (at present in general use in Germany) 13 grms. of the scum are triturated with 6–7 grms. of ammonium nitrate[1] and some water, washed into a 100 c.c. flask, clarified with 6–8 c.c of basic lead acetate, made up to bulk, and filtered and polarized. This method has hitherto been accepted as reliable, but not long ago Vondrak[2] came to the conclusion, as the result of his examination of Beyersdorfer's work on the loss of sugar occurring during the slaking of lime with sweet-water,[3] that all such methods give too low results, and that correct figures are obtainable only by the complete solution of the lime in dilute acetic acid. Kunz[4] followed up this work by examining a factory scum by all the methods at present in use, finding the polarization of the acetic acid solution of the scums to give the highest results, the deduction made being that in scums the sugar occurs, not only in the free state and as saccharate, but also in a form hitherto unrecognized, which he called "carbonate sugar," incapable of decomposition by ammonium nitrate and acid salts, and capable only of solution in acid, such as acetic. Now the authors examine the problem. First they point out that if the higher polarizations given by the acetic acid solution are due solely to sugar in some form or other, then the reducing power of the inverted liquor should correspond approximately to the amount of sugar shown by polarization. But they show that it does not On the other hand, the results obtained by determination of the sugar by Fehling's solution approach nearest to the ammonium nitrate method. They consequently conclude that by the solution of the scums in acetic acid, optically-active non-sugars pass into solution, thereby influencing the direct polarization. Evidence is given of the possibility of saponins being the optically-active substances here concerned, since Traegel has shown that they occur in scums; while it is also known that these substances have a rotation approaching that of sugar, that they can be re-dissolved by acetic acid from scums, and further that they are not precipitated by the usual amounts of basic lead acetate used in clarification.

(*B*) In connexion with the above discussion, it is here confirmed that in Vondrak's method, in which the scums are entirely dissolved in acetic acid, and the liquid polarized, dextro-rotatory substances are present, these appearing to be saponins. These substances are saponins, partly at least. They cannot be entirely removed by the addition of an excess of either neutral or lead acetate, and consequently they vitiate the value of the polarisation as an indication of the sucrose content, the degree of error depending on the amount of reagents added, and especially on whether the acetic acid solution is neutralized previous to the addition. Resinic and other optically-active substances may also be concerned.

Steam Accumulation (Ruths Apparatus). *Stanley Hopkins. J. Soc. Chem. Ind., 1925, 44, No. 8, 69-74T.* **Comparison of Evaporation in Vacuo and under Pressure in a Triple Effect Apparatus.** *F. Staudinger. La Sucrerie Belge, 1925, 44, No 5, 149-154.*

J. P. O.

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[1] In place of ammonium nitrate, a solution of zinc nitrate is specified in the "Methods of Analysis and Laboratory Control of the Great Western Sugar Co.," 1912, page 27.

[2] *Zeitsch. Zuckerind. Czecho-Slov.*, 1922-23, 311, [3] *I.S.J.* 1921, 292. [4] *Vereins-Zeitschrift*, 1924, 921.

Review of Recent Patents.[1]

UNITED KINDGOM.

Preparation of Active (Decolorizing) Carbon. *J. N. A. Sauer and N. V. Algemeene Norit Maatschappij*, of 2, den Texstraat, Amsterdam, Holland. *228,954*; addition to *198,328*.[2] August 9th, 1923.

This invention comprises a number of improvements in the process of the parent specification for preparing active carbon by subjecting a raw or precarbonized carbonaceous material to the action of heat and of activating gases in a rotary retort. One improvement consists in treating the material in suspension or in thin layers in a rotary retort mounted in a gas-tight casing. A second improvement consists in the provision of means, such as ribs, on the inner face of the retort to carry the material upwards and allow it to fall through the gases, while a further improvement is the provision of heat radiating surfaces in the retort A rotary furnace *1* is mounted in a fixed casing *2*, projects into inlet and outlet chambers *3*, *4*, and is rotated by gear wheels *23* carried by shafts passing through stuffing boxes *26* and engaging toothed collars *24*. The raw material, which may be fruit pips, peat, wood, charcoal, peat coke, lignite, brown coal, cannel coal, anthracite, etc., is charged by way of a hopper *5*, chute *6*, and conveyor *7*, while the product is withdrawn by a chute *10* into a valved collecting vessel *11*. Steam, vapours and gases may be introduced by conduits *12*, *13* and the waste gases removed by a conduit *19*, dust collector *20* and water seal *21*, any fine material carried by the gases being deposited either in the chamber *20* or in the chamber *9*. The casing *2* may be maintained at a pressure higher than atmospheric and higher than that in the member *1* such as by injection of steam and is provided with water sumps *14*, *15* for cooling and collecting dust. Any excess pressure in the various parts is removed by safety-valves *16*, *17*, *18*. The furnace member *1* may be of steel lined with firebrick, which may be provided with inlets or longitudinal channels for the admission of gases to the activating process or for the admission of combustible gases for heating by surface combustion and to this end the outer ends of the member *1* may be closed as far as the inner lining with a chrome nickel or steel alloy plating provided with a flanged opening connected by a flexible tube with the gas main. Spiral ribs or the like may be formed by the special setting of the lining of the member *1* A plurality of tubular or other furnaces in one or more casings may be combined to form a battery, the change being passed consecutively therethrough. Baffles such as longitudinal rods or tubes may be provided in the rotary tube and these may themselves be heated by gases or electrically, and if tubes are used these may divide up the chamber into a manifold of smaller furnaces. The rods may also be arranged transeversely in staggered layers, and

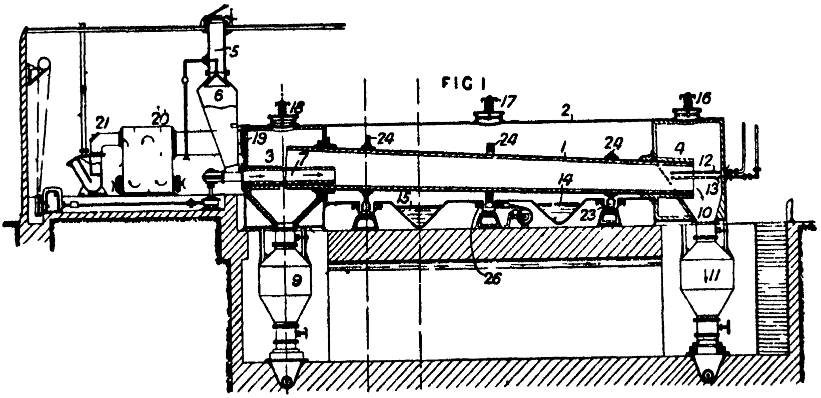
FIG I

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States*· Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

[2] *I.S.J.*, 1923, 498.

may be of silica, fireclay, or magnesia. The heating may be external and/or internal, in the latter case by injection of liquid fuel, such as crude mineral oil, petroleum or benzene, or illuminating gas, coke oven gas, Mond gas, generator gas or even powdered coal or the like. Suitable activating or purifying gases are steam, carbon dioxide, sulphur dioxide, chlorine, volatile chlorides, hydrochloric or nitric acid and ammonia. The finished product may be cooled by inert gases such as nitrogen chlorine or sulphur dioxide The various conditions of the process may be so selected as to yield the novel products described in specification 228,582. One Provisional Specification refers also to the use of other forms of moving furnaces such as a reciprocating furnace member, for example a partially open or closed tray of the "grasshopper" type.

Centrifuging Massecuite (in White Sugar Manufacture). *Willem C Roos*, of Pemalang, Tegal, Java. *22,143.* September 20th, 1924; convention date, September 20th, 1923.

Complete specification now being published, some further particulars of this patent are available.[2] It is explained that the whole method of centrifugal separation as hitherto known is unsatisfactory, by reason of the thickness of the layer formed against the wall; for, it is clear, the crystals located at the interior discharge their syrup to the crystals located more to the exterior, which crystals have just discharged their syrup to the crystals still nearer to the exterior, thus militating against complete separation. Moreover, after the removal of the sugar, usually a layer of sugar remains at the top and at the bottom of the centrifugal machine, while, in particular, when dealing with sticky massecuites, the wire gauze becomes dirty and choked. These disadvantages are removed by this invention, according to which the mass to be subjected to centrifugal action is supplied continuously in a very small stream to the centrifugal machine and the latter is rotated so rapidly that only an extremely thin layer of film is formed against the wall. As a matter of fact the layer is made so thin, and the speed is made so high, that within a single revolution of the drum, the liquid is entirely separated from the solid material of the massecuite introduced during the revolution and thrown off.

When making white sugar, the massecuite is preferably heated and diluted with water or syrup, in order to make the layer formed on the wall as thin as possible, e.g. equal to the thickness of one crystal. This heating and dilution need not be an inconvenience as the whole operation is performed extremely rapidly. The thin layer permits of increasing the speed of the centrifugal machine to a great extent, say, to 8000 revs per min. Preferably, the centrifugal machine in which the new process is carried out comprises a single drum of centrifugal gauze, but without the usual outer drum It is provided with means for supplying the massecuite, for discharging the separated sugar, and with means for loosening the sugar from the wall and for the removal of the separated syrup from the outer wall Then follows a description of the apparatus employed, essentially as already stated. It is mentioned that the drum *3* is preferably composed of gauze made from some strong, light alloy of aluminium, other than the usual material.

Treatment of Kieselguhr for increasing its Filtering Qualities. *F. W. Golby* (*Celite Company*, of Los Angeles, Cal, U.S.A.). *229,021.* November 22nd, 1923.

A product suitable for use as a filtering agent, and in the purification of sugar solutions, oils, and waste and other liquids, as an insulating material, and as an ingredient in soaps, paints and dental preparations, is obtained by calcining a finely divided mixture of kieselguhr and a salt of an alkali or alkaline earth In an example, kieselguhr is mixed with 5 per cent. of sodium chloride (as solid or in solution), and the mixture ground and heated in a muffle furnace to 1800° F., at which temperature it is maintained for one hour. For use the product is ground again.

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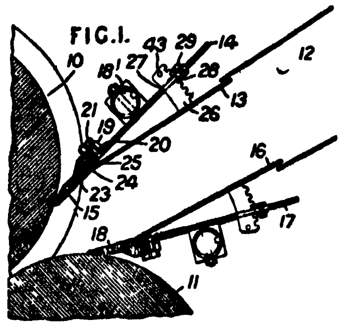
[1] See *I.S.J.*, 1923, 498.

[2] *I.S.J.*, 1924, 677.

ADJUSTABLE FEED PLATES FOR THE CARRIERS OF MILLS. *Robert W. Sharp*, of Baton Rouge, La., U.S.A. *231,102*. November 1st, 1924.

Objects of this invention are: (1) To maintain a predetermined relation between the upper and lower feed plates so that regardless of wear on the scraper toes and the adjustment of the scraper plates carrying them, there shall be secured a spacing between the upper ends of said plates of, say, 2 or 3 ins. greater than the spacing at the toes, the invention permitting one to maintain this spaced relation of the feed plates as the scraper toes wear down. (2) To obviate certain objections to modern bagasse carriers in that therein there has been no such adjusted relation of the feed plates as indicated hereinbefore, with the result that the rapid wear of the scraper toes soon leaves the spacing between the upper ends of the feed plates about the same as that between the toe ends of these plates, this rendering the feed difficult and irregular and impairing the operation and straining the equipment. The relative adjustment of the feed plates provided by this invention renders it possible to secure a bagasse feed of any desired thickness throughout an entire season without any renewal of the scraper toes and with improved milling efficiency and minimum strain and wear on the equipment.

FIG. 1.



Turning to the illustration, showing an example of the invention, it is seen that the entrance end of the carrier or shoot disposed between the macerating or expressing rollers of adjacent mills arranged in series is provided with an adjustable upwardly-inclined feed-plate *13* and an adjustable upper plate *14* carrying a scraper *15* to engage the upper roller *10* of the mill. An adjustable bottom feed-plate *16* and an adjustable lower plate *17* with a scraper *18* to engage the lower adjacent roller *11* of the mill may be provided The plate *14* is supported from a transverse beam *18*¹ which is swivelled in the side frames of the mill, and the upper portion *19* of the scraper toe *15* lies over the lower edge of the plate *14*, a steel liner *20* being interposed between the parts *14*, *19*. The toe *15* is recessed to received the liner *20* and lower edge of the plate *14* and the forward wall *23* of the recess is spaced from the lower edge of the plate *14* and is concavely recessed to receive the upwardly-curved front edge *24* of the plate *13* which bears against the rounded edge *25* of the plate *14*. The toe *15* is secured to the plate *14* by bolts *21*. A series of segmental racks *26* secured to the upper surface of the plate *13* adjacent its upper edge extend upwardly through slots *27* in the plate *14* and are engaged by a latch-plate *28* carried by the plate *14*. The plate *28* is held by a series of screws *29* extending through the upper end portions of the elongated slots *27*. Pins *43* prevent the racks *26* from escaping downwardly through the slots *27*. On loosening the screws *29*, the screws and plate *28* can be slid outwardly from the racks *26* and then the plate *14* can be adjusted to bring the toe *15* properly against the roller *10*, and the plate *13* can be lifted to adjust the passage through the shoot *12*. The bottom feed-plate *16* may be stationary, but is preferably adjustable by means similar to those of the plate *17* and scraper *18* by means similar to those of the plate *14* and scraper *15*.

FACILITATING THE FILTRATION OF RAW SUGAR LIQUORS[1] *Robt. B. Forster and Chas. M. Keyworth*, both of Leeds. *229,428*. December 10th, 1923.

Considerable difficulty is usually experienced (it is explained) in the filtration of raw cane liquors, due to the presence of gummy, oily, or waxy matters. These substances, which are very imperfectly removed in the affination process, accumulate on the fitering medium, and inhibit the process of filtration. However, the inventors have observed that a material portion of these gummy substances is volatile in steam, or is converted by it into matters which inhibit filtration to a much less degree, or both. Their invention therefore consists in submitting an aqueous solution or suspension of such raw cane sugar to steam distillation preferably at a reduced pressure. For example, 10 tons of washed raw Peruvian sugar were dissolved in water to a density of about 47° Brix at 60° C., and drawn into a Claassen type pan, heated by means of a calandria operated by low pressure steam, and provided with a perforated coil for the introduction of live steam. Steam was passed through the liquor for about three-quarters of an hour, the final temperature being 50·5°C., and the final pressure 104 mm off absolute. After diluting the liquor, its rate of filtration was compared with that of untreated liquor of like density, using a plate-and-frame type of press. In the case of the treated liquor, filtration stopped after 850 gallons had been put through the press; while in the former the press was still working after 1800 gallons had passed Claim is made for the process of: "Submitting an aqueous solution or suspension of raw cane sugar to steam distillation preferably at a reduced pressure whereby the filtration inhibiting matters present in the raw cane sugar are materially removed."

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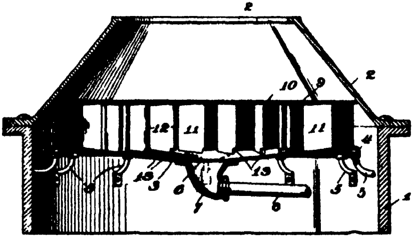
[1] See *I.S.J.*, 1924, 546, for a full account of this process.

UNITED STATES.

SAVE-ALL (OR ENTRAINMENT ARRESTOR) FOR EVAPORATORS AND VACUUM PANS. *Arthur F. Ewart and Seymour Terry,* of Honolulu, T.H., U.S.A. *1,528,104.* March 3rd, 1925

Referring to the drawings, illustrating the invention, *1* indicates the body or shell of a standard evaporator or vacuum pan, which is generally cylindrical in shape, and is provided with a generally frusto-conical top section *2* having the usual discharge opening *2'* at the top. The entrainment trap is adapted to be installed within the upper part of the evaporator chamber, in such manner that the rising vapours carrying the entrained liquid will be caused to pass laterally over the bottom of the trap, thence inwardly through the trap by way of a series of tortuous passages which produce rapid changes in direction of flow of the vapours, and present a large number of vertical walls against which the vapours impinge, the change of direction and impact of the vapours being effective in arresting and throwing out the entrained liquid. The trap proper comprises a bottom plate *3*, preferably being slightly dished or concaved toward the centre and terminating in a downwardly turned peripheral edge portion *4* which materially reinforces the bottom plate and acts as a collecting chamber for entrained liquor, and also serves as a ready means for attachment of the brackets *5*, by means of which the trap is supported within the evaporator chamber. A pipe *5* connected to the chamber formed by the peripheral edge portion *4* serves to drain the liquid collected in said chamber back into the evaporator chamber. The diameter of the bottom plate *3* is less than the interior diameter of the evaporator chamber, thereby leaving an annular space for the passage of the vapours rising in the chamber. The centre of the bottom plate *3* is provided with an opening *6* below which is secured a union *7*, from which leads drain pipe *8*, which may terminate at any

Fig. 1



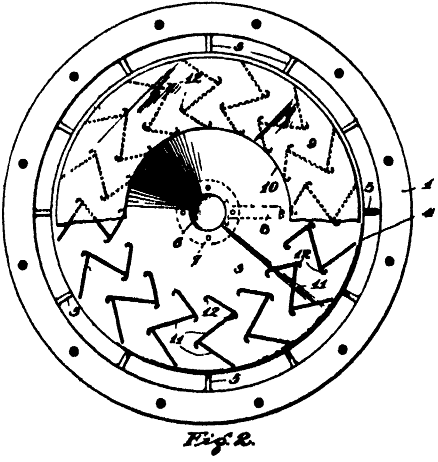


Fig. 2.

desired point in the lower part of the evaporator chamber. An upper annular plate *9*, having an enlarged central opening *10*, is spaced vertically from the bottom plate *3* by a series of vertical zig-zag baffle plates *11*, connected to the respective plates in any suitable manner, and forming a series of tortuous passages extending in a general radial direction from the periphery of the trap toward the centre thereof. The peripheral edge of the top plate *9* engages the walls of the evaporator chamber, so as to prevent the escape of vapour between said peripheral edge and the wall of the chamber. Preferably the baffle plates *11* are provided at their vertical angles, or meeting edges, with curved extensions *12* which constitute additional obstructions to the flow of the vapours through the trap and are effective in setting up vertical whirls of the vapours as the latter pass through the tortuous channels or passages between the baffles. The lower ends of the curved extensions *12* terminate short of the bottom plate *3* to permit the liquid separated from the vapours to escape from the pocket-like elements formed by the said extensions *12*. From the foregoing description, it will be apparent that the vapours generated in the evaporator, and carrying the entrained liquid, upon reaching the entrainment trap, will be deflected by the face of the bottom of the trap outwardly towards the walls of the chamber *1*, thence inwardly through the trap, where said vapours follow the zig-zag passages formed between the baffle plates, whereby the vapours are caused to change their direction of flow and are also caused to impinge with more or less violence against the vertical walls of the baffle plates, which will have the effect of arresting the entrained liquids which flow down the vertical walls and on to the bottom plate, whence they are discharged through the central opening *6* therein, and will be carried off by the drain pipe *8* to the lower portion of the evaporator chamber. As hereinbefore indicated, the curved extensions *12*, located on the elbows or angular joints of the baffle plates, will be further effective in separating the entrained liquid by setting up whirling movements in the currents of vapour passing through the tortuous passages, the liquid which is arrested within the curved extensions escaping through the opening *13* between the bottom edges of said extensions and the top surface of the bottom plate *3*.

PRODUCTION OF ACTIVATED (DECOLORIZING) CARBON. *Robert E. Wilson*, of Cambridge, Mass.; and *Joshua C. Whetzel*, of Pittsburg, Pa., U.S.A. *1,519,470*. December 16th, 1924. (Ten claims.)

Following are specific examples of the inventors' process of impregnation in carbon production.—(1). Charcoal is impregnated with a solution of a copper salt, preferably the sulphate or nitrate; the excess solution drained off, and caustic soda added to precipitate copper hydroxide in the pores of the charcoal. Then the charcoal is washed to free it from sodium sulphate or other soluble impurities and subsequently dried Certain objections incident to this method are losses of copper on account of excessive precipitation on the outside of the charcoal granules and the difficulty of washing out the sodium salt and free alkali. (2) Charcoal is impregnated with the copper salt and then iron filings, zinc dust or other finely divided metal electro-positive to copper is scattered thereon with continued stirring or raking. Electrolytic action causes the copper to precipitate on the surface and in the pores of the charcoal granules and to adhere very firmly. Zinc or iron sulphate or other salts may be then washed out with hot water and the material dried preferably at a fairly high temperature, for example 300°C, in the presence of a small amount of air to complete the removal of the sulphate. (3) In this method the copper is reduced by organic or inorganic reducing agents such as sugar, formaldehyde, etc., there being a great number of reducing agents suitable for this purpose. In this process it has been found that an ammoniacal solution of copper gives very good results. (4) Charcoal is heated up with the copper salt and the latter is reduced by the action of the charcoal itself at the high temperature. This process gives very good results in the case of the nitrate, where oxides of nitrogen are driven off, but the sulphate works well only in the presence of an excess of air as otherwise some of the sulphate is reduced to copper sulphide which injures the sorbing properties of the charcoal. In the presence of air, however, this can be carried out but there is some loss of charcoal due to oxidation.

SACCHARINE POWDER FOR ABSORBING ESSENCES, ETC. *George Washington*, of Brooklyn, New York, U.S.A. *1,512,730*. October 21st, 1924.

A comparatively thin layer of an aqueous solution of sugar is evaporated, and "the solid residue desiccated at a pressure below atmospheric and at a temperature below that of the fusing point of the material, whereby the residue is transformed into a foam-like mass of bubbles," the dry walls of such bubbles then being crushed. This material, according to the inventor, is novel, and consists of a homogeneous glass-like modification of sugar of peculiar physical structure, possessing qualities and properties not found in any of the different crystalline, granular, powdery or syrupy forms in which such substances now appear in the arts. Further he states that such residue "is eminently adapted to serve as a solid vehicle or matrix for the retention and preservation of many otherwise perishable, stimulating, or aromatic flavouring substances, from which the latter can be instantly released by simple solution."

EVAPORATOR FOR USE IN JAM, JELLY, AND MARMALADE MANUFACTURE. *Eudo Monti*. *1,520,069* December 23rd, 1924. (Two figures; three claims.)

Repeated experiments have taught the inventor that the pectin contained in apples, pears, grapes, oranges, gooseberries, currants and other fruits can be extracted by reducing the fruit to a finely divided or smashed condition and systematically exhausting the same with lukewarm water at a temperature more or less elevated, according to the kind of fruit, not exceeding 50° C. if the fruit is grapes Also that by concentrating the pectin thus extracted at a low temperature in vacuum by means of an apparatus acting continuously and automatically, concentrated solutions are obtained containing a high dry extract, without losing any of the gelatinizing power of the pectin. Pectin prepared in this way is far superior to that of juice which is concentrated very quickly by steam under atmospheric pressure. A continuous horizontal tubular evaporator, capable of maintaining a high vacuum, is described for realizing this object.

CENTRIFUGAL CLARIFICATION OF CANE JUICES[1] *Cyrus H. Hapgood* (assignor to the *De Laval Separator Co.*, of New York, N.Y, U S.A.). *1,509,355*. September 23rd, 1924.

The practice of this process involves two known principles, namely, centrifugal force and the sludging out of the solid impurities (which are of higher specific gravity than the juice) by means of an added "cushioning" liquid of heavier specific gravity than the liquid to be purified, which added liquid may or may not be of greater specific gravity than the impurities. Two liquids are used, miscible with each other, neither of which has the qualities required for a cushioning liquid, but which, when mixed in appropriate proportions, forms a solution that possesses the required properties, for example, a solution of carbon tetrachloride and paraffin. While neither of these two liquids is miscible with sugar cane juice, they are miscible with each other, and they may be mixed in proportions to give any desired specific gravity to the solution. Finally, a solution of carbon tetrachloride and paraffin does not impart any disagreeable flavour to the juice. The compound liquid and the cane juice may be fed separately into the regulating cover of the centrifuge. Preferably, the compound liquid is fed separately into the centrifuge at the periphery of the bowl so that there will be no contact between it and the juice except where the two liquid zones merge. The effect of centrifugation is to cause all the impurities to be projected against the wall of heavy liquid at the periphery of the bowl and to be thereby carried out of the bowl with such liquid.

As a specific example, one can use a solution of about five parts or slightly more of paraffin oil with two of carbon tetrachloride, thereby giving a solution of a specific gravity of about 1·11. This density is such as to allow the penetration of the solution by the impurities, whereby they are carried off. The percentage of the compound liquid to the juice will vary from 10 to 20 per cent. dependent upon the condition of the juice. The process may be performed in a centrifuge of the type shown in Snyder's U.S. Patent

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[1] See also U.S. Patent, 1,492,168, *I.S.J.*, 1924, 619.

1,283,343, which is especially adapted to the separation of a heavy liquid and solid impurities from a light liquid. But preferably, a centrifuge provided with means to convey the heavier compound liquid separately and directly to the periphery of the bowl is utilized. A good type of such a centrifuge is shown in Hall's U.S. Patent 1,411,792. Juice treated by this process will keep for a long time without spoiling, giving a raw sugar of a distinctly higher grade than has heretofore been marketed. Its refinement to one of the grades of "white" is simplified.

PREPARATION AND REVIVIFICATION OF ACTIVE (DECOLORIZING) CARBON. (*A*) *Otto Ernst and Otto Nicodemus* (assignors to *Farbwerke vorm. Meister Lucius & Brüning*, of Hochst-on-the-Main, Germany. *1,525,770.* February 10th, 1925 (*B*) *Erwin Schmidt* (assignor to *Gesellschaft für Chemische Produktion G.m.b.H.*, of Mannheim, Waldhof, Germany. *1,527,083.* February 17th, 1925. (*C*) *Christian J. Gamble*, of New Orleans, La., U.S.A. *1,528,371.* March 3rd, 1925. (*D*) *John C. Woodruff*, of Larchmont, N. Y., U S.A. *1,528,905.* March 10th, 1925. (*E*) *Jacque C. Morrell*, of Oak Park, Ill., U.S.A. *1,530,393.* March 17th, 1925.

(*A*) Claim is made for the process of preparing highly active charcoal which comprises carbonizing compressed bodies of a mixture of a fossil carbon formed after the cretaceous period with finely divided wood. (*B*) Claim is made for a method of making a highly active carbon which comprises impregnating an absorbent combustible, unrotted, cellulose-containing substance with sulphide waste liquor and thereafter carbonizing such impregnated material under temperature conditions such as to form highly active absorption carbon. (*C*) Claim is made for the process of producing a decolorizing carbon from fibrous rice material, which consists in carbonizing said material in a furnace chamber at a temperature sufficient to effect a destructive distillation, feeding to said chamber a quantity of air insufficient to consume a material proportion of the cellulosic carbon present, but insufficient to maintain the temperature needed to carbonize the material; collecting the char thus produced; and treating the same with a solution of caustic alkali to remove a material proportion of the silica present. (*D*) A process of improving spent carbonaceous material which has been used in decolorizing or purifying liquids, which comprises adding an inactive carbonaceous material directly to the spent carbonaceous material and heating the mass with an inactivating agent. (*E*) In a process of making built-up, structural adsorbent charcoal, moulding a mixture of finely divided carbon, a binder which chars on heating and other finely divided material capable of being removed by means which are not destructive to the carbon, charring the binding material therein, and activating by heating and removing the residue of said other material by means not destructive to the carbon.

BEET HARVESTERS. (*A*) *Paul Boor*, of Forsyth, Mont., U.S.A. *1,516,037.* November 18th, 1924. (*B*) *Willy Hartenstein*, of Darmstadt, Germany. *1,517,559.* December 2nd, 1924. (*C*) *Frederick W. Krafft*, of Berkeley, Calif., U.S.A. *1,517,642.* December 2nd, 1924. (*D*) *William H. Kopitke* (assignor to *The Fanger Beet Harvester Co.*, of Ohio, U.S.A.). *1,531,195.* March 24th, 1924.

BEET PULLER. *Jos. C. Kechter*, of Boulder, Colo., U.S.A. *1,530,497.* March 24th, 1925. BEET DIGGER. *Edward A. Small*, of Franksville, Wis., U.S.A. *1,526,722.* February 17th, 1925. BEET TOPPER. *Rikizo Ariuchi*, of Portland, Oreg., U.S.A. *1,528,391.* March 3rd, 1925. BEET LOADER. *William Garner*, of Longmont, and *Fay Garner*, of Erie, Colo., U.S.A. *1,522,007.* January 6th, 1925.

FILTERS. (*A*) *David M. Berry*, of Oakland, Calif., U.S.A. *1,516,702.* November 25th, 1924. (*B*) *Ernest J. Sweetland* (assignor to *United Filters Corporation*, of Delaware, U.S.A. *1,510,568.* October 7th, 1924. (*C*) *Werner Hoehn*, of New Orleans, La., U.S.A. *1,531,093.* March 24th, 1925.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1925 Tons.	1924. Tons.
Total Receipts, January 1st to May 27th	1,609,359	1,486,371
Deliveries ,, ,,	1,502,511	1,433,372
Meltings by Refiners ,, ,,	1,386,930	1,305,710
Exports of Refined ,, ,,	95,000	65,000
Importers' Stocks, May 27th	106,848	53,793
Total Stocks, May 27th	237,786	200,694
	1924.	1923.
Total Consumption for twelve months	4,854,479	4,780,684

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1922-1923, 1923-1924, AND 1924-1925.

(Tons of 2,240 lbs.)	1922 23 Tons	1923-24 Tons	1924 25 Tons
Exports	1,912,392	1,891,350	2,185,378
Stocks	756,155	940,715	1,158,245
	2,668,547	2,832,065	3,343,623
Local Consumption	40,000	40,000	60,000
Receipts at Port to April 30th	2,708,547	2,872,065	3,403,623

Havana, April 30th, 1925 J. GUMA.— L MEJER.

Sugar Crops of the World.

(Willett & Gray's Estimates to May 28th, 1925)

	1924 25 Tons	1923-24 Tons	1922-23. Tons
CANE.			
America	8,174,652	7,055,255	6,578,746
Asia	5,436,490	5,909,840	5,460,112
Australasia	505,680	339,859	343,832
Africa	573,696	572,035	556,853
Europe	10,629	7,871	13,918
Total Cane	14,701,147	13,884,860	12,953,461
BEET.			
Europe	7,175,000	5,057,761	4,574,325
U S.A.	974,185	787,217	615,936
Canada	36,200	16,500	12,400
Total Beet	8,185,385	5,861,478	5,202,661
TOTAL CANE AND BEET	**22,886,532**	**19,746,338**	**18,156,122**

United Kingdom Monthly Sugar Report.

Our last report was dated the 11th May, 1925.

The tendency of the market during the period under review has been quiet and slightly easier. There have been fluctuations up and down but generally speaking there has not been much material change in prices.

Business on the terminal market has been on a moderate scale. The speculative interest generally is being transferred from the old to the new crop. The May account continued to be liquidated right up to the last day, over 17,000 tons were tendered in all and large quantities were dealt in during the month at prices ranging between 16s. 2¼d. to 16s. 10½d., the final price being 16s. 3¾d. Isolated transactions took place in June and July, but the chief business in old crop took place in August which month sold from 16s. 9d. to 17s. 1½d. to 16s 3¾d. to 16s. 9d. to 16s. 2¼d to 16s. 7½d. New crop continued to be active and a good volume of both selling and buying orders has been placed. October/December, both together and separately, have been largely dealt in but December alone is the delivery which has attracted most interest. This latter month moved from 16s. 9d. to 17s. 1½d. to 16s. 4½d. to 16s. 9¾d. to 16s. 3d. to 16s. 8¼. March sold from 16s. 9d. to 17s. 3d. to 16s. 6¾d. to 16s. 10½d. to 16s. 4½d to 16s. 10½d. Latterly May, 1926 was dealt in at 16s 7½d. to 17s. The latest prices are June 16s. 5¼d, August 16s. 6¾d., December 16s. 7½d, March 16s 10½d.

Trading in actual sugars has not been so active as during the previous month. Prices have not altered materially and slight fluctuations have taken place from time to time according to the movements in the terminal market. Fine Granulated on the spot sold from 29s. 9d. to 29s. 6¾d. to 29s. 10½d. duty paid, less 1½ per cent. A large business has been done in Canadian and American Granulated which sold from 17s. 6d. to 17s. and then up to 17s. 3d. c.i f. London, while to other U.K. Ports 1½d. to 3d. over this price has been obtainable. Czecho Sugars have not been pressed for sale, in fact a scarcity exists and it has been extremely difficult to buy either for ready or forward deliveries. Dutch Granulated has been more plentiful and ready and forward have been sold from 16s 10½d. to 16s. 7½d to 17s. to 16s. 10½d. Belgium, although at first still remaining out of the market, has recently shown more inclination to come into line with other sugars and the latest price for Belgian Fine Granulated is 16s. 9d and Belgian Crystals 16s. 4½d. White Javas for May/June and June/July shipments have recently come nearer the European parity, and at one moment were sold at 15s. 10½d. c.i.f. U.K. The latest value is 16s. 3d.

The British and Continental Refiners have been continual buyers of raws, and business has been done in Cubans and San Domingos from 12s. 4½d. up to 12s. 9d.

The U.K. Refiners have continued to do a steady trade and have been busy delivering old contracts, but no change has been made in their prices which are to-day No. 1 Cubes 35s. 3d., London Granulated 31s. 1½d.

A large business has been done in America where—owing to the very hot weather prevailing—the demand from the trade has improved. The Refiners have bought heavily and the price of raws has advanced from 2½ to $2\frac{11}{16}$th cents.

The Cuban crop continues to progress favourably and points to the latest estimates being realized. The receipts to date are nearly 800,000 tons more than last year. The exports are 400,000 tons more than in 1924, so that if the crop should outturn 5,000,000 tons there will still exist a surplus of 600,000 tons to be disposed of.

With regard to the European sowings, the latest estimate from Mr. F. O. LICHT gives a minus of only 0·6 per cent. for the whole of Europe. The crop apparently had a good start but recently there have been complaints of dry weather, particularly from Germany and Poland, and also there are unconfirmed rumours that the crops have been damaged in these countries by insects.

21, Mincing Lane,
London, E.C. 3.
June 9th, 1925.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE

INTERNATIONAL SUGAR JOURNAL.

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No. 319. JULY, 1925. Vol. XXVII.

Notes and Comments.

Imperial Preference in Parliament.

The Finance Bill of this year's Budget was considered in Committee in Parliament during June, which implies as a rule the threshing out of the details of any new proposals. But as regards the new Imperial Preference on sugar, the debate was of a singularly unimportant character. For one thing, it came on in the middle of an all-night sitting of the House, when most members were obviously too tired lightly to prolong the debate. For another thing, the feeling in the House of Commons in favour of Imperial Preference is no longer confined to the Government benches; quite a number of Labour men are in favour of it, while others are inclining that way. Hence when the new rates on Imperial sugar came up for discussion it was chiefly "die-hard" free traders who rose to oppose the measure. But, as one member not incorrectly put it, the debate was an object lesson in rhetoric and repetition; there was nothing new brought to the subject, and it was a foregone conclusion that the Government would carry their proposals by a comfortable majority—to be precise, by 190 votes to 58 in a thin House.

Mr. CHURCHILL, who spoke for the bill, declared that Imperial Preference dated from 1917 when the Government of the day, composed of all parties, gave its consent to the principle. He was sorry that last year Mr. SNOWDEN went out of his way to overturn the guarantee that had been given to the Colonies; he thought it was a wanton act to do, as it appealed to the prejudices of certain members who feel they are serving some public course by attacking the principle of Imperial Preference in every way and at every opportunity. A considerable number of the most valuable members of the Labour party now took the view that if no burden is placed upon the necessities of life, reasonable preference may well be given to the Dominions. Defending the Government's decision to maintain the preference on sugar for ten years unchanged, he asked how in any other way were they to develop sugar estates? If the West Indian sugar industry failed for support, the only alternative would be grants-in-aid. We would be compelled then to put upon the Votes of Parliament charges each year of so many hundreds of thousands of pounds to relieve the burden of the West Indies, or else leave the islands derelict, a step no Government would consent to do. It was thus absolutely essential that we should deal in a practical measure with the preference of sugar in the West Indies, and so encourage the Colonies to become self-supporting.

Mr. Baldwin on Home Grown Sugar.

Last month a day in Parliament was given to an Opposition motion censuring the Government for not having done anything practicable for the alleviation of unemployment. Mr. Baldwin's reply showed that quite 90 per cent. of our people were employed, and that the bulk of the remainder was largely confined to our staple industries—coal, wool, and cotton, where economic factors that no Government could overcome were the deciding issue. Till those industries could adjust their economic basis so as to enable them to compete under present conditions in the world's market, little can be done by any Government intervention to foster their activities.

But the Government are doing what they can to foster agriculture at home, and the sugar industry was cited by Mr. BALDWIN as a bright spot in the relief of labour. He gave the following figures as illustrating the extent to which the home beet sugar industry had already developed as an employer of labour. Sugar, he said, employs ten men for every 100 acres of roots grown. In 1919 there were 400 acres of beet, last year 23,000 acres, while this summer 50,000 acres have been sown, which means that 5000 men have been found work in the beet fields; in addition, some 3000 men are in continuous employment putting up factories for the coming autumn campaign. Ten factories which will then be working will employ another 5000 men, chiefly unskilled, during the winter months, and this will tend to a decasualization of the labour that is brought into the country districts in the summer for the purposes of haymaking and harvesting. In addition these factories mean a permanent staff of chemists, foremen and engineers, amounting to 600; they will take 5000 tons of coal, 2500 tons of limestone, and all the consequent transport. This is what the industry involves as a start, and it may easily grow, in Mr. Baldwin's opinion, to one of very great dimensions. He admitted that the question of providing the capital for new factories was not an easy one, but he hinted that the Government would do all they could to assist that side of the problem, so as to enable the speed to be accelerated at which those factories would be multiplied all over the country.

Death of Mr. Truman G. Palmer, the Statistician.

A loss to the sugar world at large is caused by the sudden death from bronchial pneumonia of Mr. TRUMAN G. PALMER of Washington. In his position as executive secretary of the American Beet Sugar Association, the United States Beet Sugar Industry, and the United States Sugar Manufacturers' Association, he acquired fame second to none as a sugar statistician, and his loose-leaf perennial, "Concerning Sugar," which has been in existence for about ten years, has supplied the most complete set extant of figures in accessible form showing the development of the various sugar industries of the world. Mr. PALMER was a strong protagonist of the American indigenous sugar industry and had no wish to see it swamped by tropical cane sugar such as Cuba provided. It was only in March last that we printed a contribution of his on the Relation of the Beet Sugar Industry to American Prosperity, which contained food for thought for our own home beet sugar industry. Mr. Palmer's death at the age of 67 comes as a loss to all interested in sugar; but one must express the hope that it will not result in the abandonment of his most noteworthy work, the "Concerning Sugar" series above referred to.

The New Mauritius College of Agriculture.

An interesting event in Mauritius took place on March 12th last when the formal inauguration of the Mauritius College of Agriculture was performed by the Governor of the Colony. In the course of an introductory speech the

Director of Agriculture (**Dr. H. A. Tempany**) emphasized that the College was not really a new departure but was merely an important mark in a continuous sequence of development. The movement, of which this building was the embodiment, took its rise some 35 years ago, when the late Mr. **Boname**, then Director of the Station Agronomique, inaugurated the practice of taking one or two pupils for training as Agricultural Chemists. When the Department of Agriculture was created in 1913, Mr. **Stockdale**, the then Director, was quick to recognize the value of the work already accomplished and proceeded to extend it. He standardized the courses of instruction, started occasional courses of lectures, and introduced the general study of agriculture into the curriculum. In 1921 the Chamber of Agriculture and the Société des Chimistes decided that the time was ripe further to broaden the teaching so as to make the existing School of Agriculture into a training ground not only for factory chemists but also for estate employés and future administrators and managers. As a result of prolonged discussion the present scheme was evolved; it provided for the erection of a new College of Agriculture, the working out of courses of instruction, the engagement of additional teaching staff, the provision of scholarships for the study in other countries of sugar agriculture and manufacture by selected students of the institution, and the extension of research facilities. The requisite funds for the scheme have been provided by planters from special taxation, the cost of the building having been voted from the Improvement and Development Fund, while the working expenses are provided from the proceeds of a special export tax on sugar. The total cost of the building and of the equipment has been Rs. 200,000 (say £12,500), of which Rs. 142,000 have come from the Development Fund.

THE MAURITIUS COLLEGE OF AGRICULTURE

Although the date originally fixed for the completion of the building was the commencement of 1925, the teaching work was started at an earlier date in temporary premises, so that the curriculum was able to transfer to the permanent building in full working order. Particulars of the courses have already been outlined in a previous issue of our journal,[1] so need not be repeated here. But we give a photo reproduction of the fine new building, which looks in every respect worthy of the rôle which it is to serve in educating Mauritian agriculturists in the highest branches of their industry.

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[1] See *I.S.J.*, 1923, 351.

Prof. Harrison's Connexion with Barbados – A Correction.

In our May issue in the course of a tribute we paid to Mr. J. R. Bovell's long connexion with Barbados, we unwittingly did an injustice to Professor J. B. HARRISON, when we stated that the latter was not in Barbados in 1884 when the seedling cane experiments were started.[1]

As a matter of fact, Professor HARRISON was in Barbados from 1879 to 1889, and, as NOEL DEERR states in "Cane Sugar," he co-operated with BOVELL in the experiments in question; these latter however did not start in 1884, but in 1887-88 when seedlings were discovered growing on Dodds Experimental Farm.

We are indebted to several correspondents, especially to Dr. C. A. BROWNE of Washington, for putting us right in the matter of these Barbados experiments. Dr. BROWNE reminds us that sugar cane seedlings were first discovered in Barbados as far back as 1858, on the property of Mr. J. W. PARRIS, who stated that these were from Bourbon, Transparent and native canes. The discovery was contradicted and was not immediately followed up, but it established a tradition which undoubtedly influenced Mr. BOVELL thirty years after. The latter started work at the Botanical Station of Dodds Reformatory in 1884 on cane variety experiments and in 1885 undertook manurial experiments. Early in 1888 the overseers of the station discovered in a field that had not been weeded for some weeks a number of plantlets, that BOVELL soon proved to be young seedling canes. These were taken up and transplanted and in their new quarters developed into sugar canes. At the end of that year Mr. BOVELL sowed several boxes of sugar cane arrow spikelets and in a short time was rewarded by seeing a number of them germinate; he also that year collected a number of self-sown seedlings.

The actuality of the germination of cane seed when the discovery was re-announced was however again disputed; and it was not till Prof. HARRISON and Mr. BOVELL had demonstrated the fertility of cane seed by actual germination tests that all doubts were removed.

These appear to be the facts as to the inception of seedling experiments in Barbados, and we regret that by inadvertence we should have deprived Professor HARRISON of his share of the achievement, instead of coupling his name with that of Mr. BOVELL as co-operators in demonstrating the truth of the theory suggested by the accidental discovery of seedling canes at Dodds.

The Anglo-Scottish Beet Sugar Corporation's First Meeting.

The first annual general meeting of the Anglo-Scottish Beet Sugar Corporation was held in Glasgow last month when Lord WEIR presided. The report and accounts circulated covered a period of 13 months dating from the formation of the Corporation in January 1924, and concluding with the completion of their first manufacturing campaign at Colwick. That period was largely one of vast organization, both of the factory and of the agricultural sources from which the roots were obtained, while the training of a suitable personnel was no small task. In these circumstances it is gratifying to find that the balance sheet, after making provision for the usual charges, discloses a net profit of £14,729 (the ordinary capital is now £425,000). Lord WEIR ascribed much of this success to the successful design and layout of the Colwick factory by Messrs. Duncan Stewart & Co., Ltd., while he paid tribute to the technical and organizing capacity of their general manager, Mr. **Wiese**, and his assistants. A feature of the staff is a group of young students who have worked enthusiastically on all the processes in the factory during the campaign, and in the off season are studying sugar technology; these, it is expected, will become in the future the backbone of a corps of capable British sugar experts.

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[1] As we stated at the time, the account we gave of Mr. Bovell's career was supplied us by a correspondent in the West Indies and we had no reason at the time to doubt the accuracy of his historical data.

Colwick was successful in turning out a direct consumption sugar of such a high quality that it immediately established itself on the sugar market as "Anglo-Scottish Standard" and already holds an honourable place in Mincing Lane.

But while high factory efficiency seems now assured, much rests on the ability of the farmers to grow beet cheaply and on a large scale. The first year's results have shown conclusively that beet of high sugar content can be produced, and a fair proportion of the growers are already able to obtain tonnage yields per acre almost comparable with Continental results. But the average yield per acre is still much too low, and till the farmers acquire the experience to increase it, the subsidy given by the Government will serve the useful purpose of covering their high development costs till they have established themselves as efficient growers of beets. The experience of the Corporation already indicates that the British farmer intends to play his part effectively.

The immediate programme of the Corporation includes new factories at Spalding and Kidderminster to operate in the coming Autumn, and a third factory in the York district which will be ready next year. Further than that the Company prefer not to expand till they see the results of a second year's operations at their existing factories. But they propose to erect a special plant at Colwick for the recovery of sugar from molasses and the treatment of other by-products.

Altogether, the first report of the Anglo Scottish group is of an encouraging nature and indicates the thoroughness with which the directors have embarked on a new enterprise of a highly technical character and one that is comparatively novel to this country.

Wissington Sugar Factory.

Last month subscriptions were invited from the public to take up at par 350,000 £1 shares in "British Sugar Manufacturers Limited," the company that is erecting a new beet sugar factory at Wissington in South-west Norfolk. Reference has already been made in our pages to this factory,[1] the machinery and plant for which are being supplied by Messrs. Craig & Co., Ltd., of Paisley. The Directors are Mr. A. T. **Radcliffe** (of the Mambre Sugar and Malt Co., Ltd.), Mr. C. J. **Bailey** (a partner in E. D. & F. Man, the Mincing Lane sugar brokers), Colonel H. W. **Burton**, M.P., Mr. W. A. **Towler** (a large landowner near the factory), and Mr. J. R. **Milne** (of Sir Robert McAlpine & Sons, Ltd.). The registered offices are at 1, Cornhill, London, E.C.3.

Three-year contracts have already been arranged by the Company with the growers, and over 4500 acres were planted last Spring. The factory is situated on the River Wissey, a canalized tributary of the River Ouse, by means of which it is connected with the port of King's Lynn. In addition there is a private standard gauge line leased to the Company, which extends for about 11 miles through a rich beet growing district and connects with the railway line about two miles away. By means of this line growers will be able to deliver roots to the factory at specially cheap rates. The factory is to have a designed capacity for treating 600 tons of beet per day. The buildings are being erected by Sir Robert McAlpine & Sons, Ltd., the boilers are from Babcock & Wilcox, Ltd., the General Electric Company are supplying the electrical plant and equipment, while the

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[1] See May issue, page 235

Skoda Works in Czecho-Slovakia are supplying certain special items of beet sugar machinery to an extent not exceeding 25 per cent. of the total cost of plant and machinery. The total cost of the freehold site, factory, and full equipment is expected to be £280,000, and the factory should be at work the coming Autumn.

Progress of the Sugar Industry in Hawaii.

In a short paper presented to the last annual meeting of the Association of Hawaiian Technologists, Mr. W. VAN H. DUKER dealt with some aspects of the progress of the Hawaiian sugar industry since it started. During the last thirty years, the production of sugar in ten-year periods has been: 1894-1904, 2,738,418 short tons; 1904-1914, 4,945,199 tons; 1914-24, 5,932,715 tons. This rapid development, in his opinion, is due, at the very foundation, to the co-operation of capital and science. As early as 1883 the sugar planters combined in an effort to secure a suitable labour supply, and this combination later on developed into the Hawaiian Sugar Planters' Association. In 1895 the Experiment Station was organized, and from that time there dates the more tangible development of the technical side of the industry. A worthy list of inventions to the credit of progressively spirited local men has in no small measure been instrumental in making the industry what it is to-day. Amongst these may be cited the Weston Centrifugal in 1855; the Juice Strainer, Cush Cush Elevator and Automatic Bagasse Feeder (by John A. Scott) in 1895; the Kopke Clarifying Centrifugal in 1909; Messchaert's Juice Grooves in 1913; Searby's Shredder in 1914; the Ramsay Maceration Scraper in 1916; the Meinecke Chute in 1921; and Peck's Revolving Juice Screen in 1922.

The Chemical Division of the Association is of course primarily interested in the question of recovering the largest quantity of sugar out of the cane at the lowest possible cost. Taking as a basis the average per cent. sucrose recovery, for the years 1909 to 1913 inclusive, the figure was 85 46, while for the next ten years (1914 to 1923) it was 87·56 per cent. During the latter period 6,545,297 tons of sucrose were delivered in the cane to the factories. If the percentage sucrose recovery had remained at the figure of 85·46, 5,791,151 tons of sugar (at 96·6 pol.) would have been the output. But due to the application of technical knowledge and the improvement in equipment, the amount was 5,932,715 tons, or 141,564 tons more. At the moderate valuation of $75 per ton, this has meant an additional ten and a half million dollars for the ten years.

Two factors, according to Mr. DUKER, have been at work to make such an accomplishment possible; first of all the period of increased efficiency and standardization, and, secondly, the exchange of mill data and the annual synopsis thereof. To those who depend in their judgment upon information contained in these data this synopsis or study of factory accomplishment is of the greatest value. Weekly reports of comparative mill data are extensively used and eagerly awaited by ambitious engineers and factory superintendents.

Mr. DUKER believes that from now on their greatest gain must come from a further improvement in the quality of the cane as it is received at the mills, and on their success in learning more about the quality of the impurities and in overcoming their influence on the yield. No factory improvement, he points out, is able to recover the losses due to deterioration of the raw material itself.

In a broad sense, he concludes, the development of the world's sugar industry is practically unlimited. The world's consumption of sugar in 1924 is estimated at 20 million tons; but if the *per capita* consumption of the world's total population were equal to that of the United States (112 lbs.), some eighty million tons would be required to supply the demand. Great problems lie immediately ahead, well worth the study and thought of everyone connected with the technical development of the industry. Eliminating the refinery operations and making refined sugar direct from the cane is one of them; recovering the sucrose now lost in the final molasses, amounting to from 6 to 8 per cent. of the total supplied to us by nature, is another.

The Outlook for Australian Sugar.

A message to the *Times* from its Australian correspondent suggests that over-production is threatened in the Australian sugar industry to an extent that may cause serious embarrassment. The new crop is expected to amount to half a million tons, and since the Commonwealth consumption is about 300,000 tons, there will be a surplus of 200,000 tons to dispose of on the world's market at competitive prices, which are of course lower than those ruling in Australia. The last agreement made between the Government and the industry stipulated that the mills were to be paid £27 per ton, out of which the growers received £18. Loss on the exports was to be borne by the Sugar Pool. As a result of the favourable price offered them, the growers increased their output and last year there was a surplus of 100,000 tons; out of this 75,000 tons was exported at £21 per ton and the Pool had to make up a loss of £450,000 or 30s. per ton of the entire production. Hence the mills and growers only got £25 10s. per ton.

This year the growers have increased their output, to the extent that an export surplus of 200,000 tons is indicated. On this production a loss of two millions is expected, entailing a drain upon the Pool of £4 per ton of the whole output. This will reduce the price to the mills to £23 at least, while an even lower figure is not impossible if the world's price drops further.

As our Australian correspondent, the late Mr. **Chataway**, pointed out last January, the growers have had to take less for their cane, since the mills cannot bear a reduction in the price for the sugar without passing it on to the farmers. The profit they make is too moderate; seven typical mills more or less under Government control were shown by him to make in no instance as much as £1 per ton, 19s 6d. being the highest, and a loss of 15s. 11d. the lowest figure. The problem would seem to be then how much of the above-mentioned £4 loss the mills can pass on to the growers and whether it will be sufficient to discourage the latter from expanding the cane crop yet further. Otherwise it seems conceivable that the mills will be in danger of going bankrupt before the farmers deem that prices are no longer remunerative enough to warrant growing cane for 500,000 tons of sugar.

Fulton Plants in Cuba and Elsewhere.

The Fulton Iron Works Company of St. Louis report that their engineering plant is running at full production on sugar cane machinery orders. Sales for the first six months of 1925 have exceeded sales during the same period of last year by more than 40 per cent. Unfilled orders include two of the largest cane milling plants ever built, each being capable of grinding more than 4000 tons of cane in 24 hours of rated capacity. One of these tandems will be installed at Central Santa Marta, owned by General **Mario Garcia Menocal**, Ex-President of Cuba, and the other is destined for Central Cuba, owned by Colonel **Tarafa**, president of the North Railroad of Cuba and author of the famous "Tarafa" Bill. It is interesting to note that approximately 125 American freight cars will be required for the shipment of these two installations to the location of the factories in Cuba.

In addition to the above, the Fulton Iron Works Co. is furnishing extensive additions to Central San German, owned by the Atkins' interests, Central Santa Catalina, and other important factories in both Cuba and Porto Rico.

Fifty Years Ago.

From the "Sugar Cane," July, 1875.

In this number of our predecessor the article on "The Central Factories of Martinique" mentioned last month was continued, and at the end of it some figures were summarized for the five estates considered, which were probably amongst the most modern and efficient of that time, some of the averages of these being here reproduced: Sugars made per cent. cane, 6·82; tons of cane for one ton of sugar, 14·7; molasses made per cent. cane, 2·5; average price of molasses per gall., 8·1d.; rum in gall. obtained from 100 gall. of molasses, 74·0; average price of rum per gall., 16d.; tons of coal per 100 of sugar made, 94; and lbs. of coal per ton of cane ground, 133. Correlating the chief expenses to the total cost of the sugar, it was stated that the cost of the cane was 66 per cent.; of fuel 8·9; of labour, 6·1; and of "maintenance," 6·7 per cent. One ton of cane cost, 19s. 5d.; "mean working expenses," 10s. 1d.; a total of 29s. 6d.; from which one deducts the mean value of the product leaving 6s. 11d. as the mean gross profit on one ton of canes. As to the profits obtained three of these factories gave as the nett profit on percentage of the subscribed capital 15·8, 13·5 and 9·3 per cent. (without deduction for reserve and sinking funds); whilst the other two were returned as unprofitable, both making a slight loss in this particular year.

Colonel R. A. Stewart, delivered an address in Kingston, Jamaica, deploring the method of making sugar then in vogue, and pointing out the advantages of his process, namely sulphitation. He pointed out the rôle of lime in clarification, and emphasized the importance of using the best quality of that chemical obtainable. Of his process he claimed "that sulphurous acid is an antiseptic from the moment it touches the cane juice, and enables the use of a larger amount of lime, which more efficiently destroys the gum; that it separates the feculent matter from the juice, incorporates itself with the gum, gluten, and fecula generally, and forms on the lime as a base, thereby decreasing the specific gravity of the lime, and assists in raising it to the surface, acting as a rising filterer as soon as heat at the temperature of 206° is applied.

G. C. Stewart, of Greenock, continued his article entitled "Notes on Sugar Analysis." In determining reducing sugars volumetrically, no indicator for showing the presence of unreduced copper in the boiling liquid was used, the end-point being judged by the "characteristic red colour" of the precipitated red suboxide, which could not have given very accurate results. "Extractive organic matter" was obtained by him by treating a solution of the raw sugar under examination with basic lead acetate, raising the liquid to boiling point, filtering through a tared filter, washing well, and lastly weighing after drying to constant weight. But this must have given a figure quite far from the truth.

In this issue about a dozen patents were summarized, among them that of G. W. Risien[1] for a maceration process, in which the bagasse was carried from one mill to the next by a carrier through a bath of hot liquid for the saturation of the material; and one by John Girdwood[2] which concerned the clarification of cane juice using bisulphite.

During the grinding season ending in May this year, the Cespedes Sugar Company, owning and operating Central Cespedes of Camaguey Province, Cuba, produced 354,240 bags of sugar (containing 325 lbs. each), which is believed to be a world's record for a factory operating one grinding tandem. Cespedes' milling equipment consists of a double crusher and 18-roller mill, motor driven, manufactured by the Fulton Iron Works Company of St. Louis, for a capacity of 250,000 bags.

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[1] No. 4094 of 1874. [2] No. 4153 of 1874.

The New Preference on Empire Sugar.

Scale of Duties.

The following figures, derived from the Finance Bill now before Parliament, give the scale of preferential reductions off the Customs Duties that are applicable to Empire-produced sugar. The full scale Customs Duty is added for comparison.

PREFERENTIAL REDUCTIONS OF CUSTOMS DUTIES IN CASE OF SUGAR AND MOLASSES.

Article		Amount of Reduction s	d.		Full Rate of Duty, per cwt £	s	d.
Sugar which, when tested by the polariscope indicates a polarization exceeding 98°	the cwt.	4	3⅓	..	0	11	8
Sugar of a polarization not exceeding 76°	,,	2	0⅔	..	0	5	7
Sugar of a polarization—							
Exceeding 76 and not exceeding 77 ..	,,	2	1·5	..	0	5	9 4
,, 77 ,, ,, 78 ..	,,	2	2·3	..	0	5	11·6
,, 78 ,, ,, 79 ..	,,	2	3·1	..	0	6	1·9
,, 79 ,, ,, 80 ..	,,	2	4·0	..	0	6	4 1
,, 80 ,, ,, 81 ..	,,	2	4·8	..	0	6	6·4
,, 81 ,, ,, 82 ..	,,	2	5 6	..	0	6	8 6
,, 82 ,, ,, 83 ..	,,	2	6 4	..	0	6	10 8
,, 83 ,, ,, 84 ..	,,	2	7·3	..	0	7	1·4
,, 84 ,, ,, 85 ..	,,	2	8·3	..	0	7	3·9
,, 85 ,, ,, 86 ..	,,	2	9·2	..	0	7	6·4
,, 86 ,, ,, 87 .	,,	2	10·1	..	0	7	8 9
,, 87 ,, ,, 88	,,	2	11·1	..	0	7	11 7
,, 88 ,, ,, 89 .	,,	3	0 2	..	0	8	2·5
,, 89 ,, ,, 90 ..	,,	3	1 4	..	0	8	5 9
,, 90 ,, ,, 91 ..	,,	3	2 6	..	0	8	9·2
,, 91 ,, ,, 92 ..	,,	3	3·9	..	0	9	0·6
,, 92 ,, ,, 93 ..	,,	3	5 1	..	0	9	4 0
,, 93 ,, ,, 94 ..	,,	3	6·3	..	0	9	7 3
,, 94 ,, ,, 95 ..	,,	3	7 6	..	0	9	10·7
,, 95 ,, ,, 96 ..	,,	3	8 8	..	0	10	2·0
,, 96 ,, ,, 97 ..	,,	3	10 0	..	0	10	5 4
,, 97 ,, ,, 98 ..	,,	3	11·3	..	0	10	8 8
Molasses (except when cleared for use by a licensed distiller in the manufacture of spirits) and invert sugar and all other sugar and extracts from sugar which cannot be completely tested by the polariscope and on which duty is not specially charged by reference to the other provisions of this Part of this Schedule:—							
If containing 70 per cent. or more of sweetening matter	the cwt.	2	8¼				
If containing less than 70 per cent. and more than 50 per cent. of sweetening matter—	the cwt.	1	11⅛				
If containing not more than 50 per cent. of sweetening matter	the cwt.	0	11¼				

The amount of sweetening matter to be taken to be the total amount of cane, invert and other sugar contained in the article as determined by analysis in manner directed by the Commissioners.

Technique in raising Cane Seedlings.

The raising of seedling canes has now been attempted in practically all parts of the world where sugar cane is cultivated on an extensive scale; but, considering the wide interest which has been shown in the subject, it does not appear to have been treated as seriously as its importance from the crop point of view warrants. In the past, it is true, useful results have been obtained here and there, even by enthusiastic planters who have made it their hobby, and the cane fields owe some of their most esteemed varieties to the labours of these pioneers. But in most of the experiment stations the raising of cane seedlings has been treated more or less as a side issue, the officers in charge, saddled with much other work, generally being content with somehow producing satisfying figures as to the number of seedlings obtained each year, with little real study as to their immediate adaptation to the special requirements of the country of origin. Here, again, some notable results have been obtained, especially in Java and Barbados; but it must be conceded that a vast amount of profitless labour has been too frequently dissipated, through lack of a real scientific study and understanding of the subject. In certain places, such as Natal, Louisiana, and (in the past) India, sporadic efforts at raising cane seedlings have been made without much success, and this lack of result has usually been comfortably assigned to inherent sterility of the varieties or adverse climatic conditions. In the last-named country, however, when about a dozen years ago a special scientific officer was placed in charge of the work, the cause of previous failure was quickly determined; in no other place are such masses of fresh seedling canes produced every year as in India to-day, and, once the initial difficulties had been overcome, progress in the scientific knowledge of the subject has been rapid and continuous.

It is now generally accepted that the greatest outturn of sugar per acre can only be obtained, in the first instance, by a close adaptation of the variety to the local environment, whether as regards soil, temperature or moisture, and that the introduction of varieties (whether seedlings or not) from other countries can only lead to a very partial solution of this problem. It is being increasingly felt that the only way to solve it satisfactorily is by the appointment of a whole-time officer, with the requisite scientific training, in each separate country, so that an adequate study can be made of the available parents, and by suitable combinations of these seedlings can be raised and fully tested in all directions before being let loose for general trial. To realize the importance of this local intensive study, it will suffice to compare the general character of the seedlings raised in Java, Barbados, British Guiana, Mauritius, Hawaii, Queensland, and India. From a careful analysis of the general facies of these collections of seedlings, it is still possible sometimes to reap considerable advantage by their introduction to fresh localities, although the results of the wild rushes for specimens of seedlings, of outstanding merit in certain special conditions, e.g., of B 208 and H 109, must by now have demonstrated that progress along these lines is distinctly limited; the dream of a universal domination of one super-excellent cane can no longer be indulged in. Besides this, the time has now come when the indiscriminate exchange of cane varieties between different countries is no longer possible, because of the increasing imposition of quarantine regulations to guard against the broadcasting at the same time of serious pests and diseases. All of which, coupled with the general belief that a time of serious competition between all cane-growing countries is imminent, works together for the immediate institution of a separate seedling department, under a properly trained whole-time specialist, in each country wishing to take a part in the production of cane sugar on any large scale. An officer saddled with other duties will no longer suffice; and, if anyone is doubtful on this point, it will be sufficient to refer him to a careful perusal of two papers printed in the Proceedings of the Third Annual Meeting of the Association of Sugar Technologists at Honolulu in October of last year.[1] It will be noticed that, although these two papers differ as the poles, they are both mainly concerned with only one aspect of this many-sided subject, namely, the actual methods employed in nursery work. W. P. **ALEXANDER** presents in detail the methods being adopted by five independent cane growers in Hawaii who raise a considerable number of seedlings every year; and a welter of problems are seen to need solution in one comparatively small country, where it appears to be doubtful whether a special officer is giving his undivided attention to the subject. T. S. **VENKATRAMAN**, on the other hand, summarizes the procedure evolved during the past dozen years at the Cane Breeding Station at Coimbatore in south India, with the apparently simple, clear-cut object of raising seedling canes superior to the existing varieties grown over the immense north Indian, extra-tropical tract. In both of these papers the nursery practice is seen to be dominated by local conditions of environment, and **ALEXANDER** adds very brief statements of certain items of procedure in India, Java, Mauritius, Fiji, Australia, Porto Rico, and British Guiana, all obtained direct from the pen of officers in charge of or acquainted with cane breeding in these countries. These paragraphs form an extremely interesting addendum to the mass of local differences in Hawaii, which forms the body of the paper; and incidentally make one wish for a good deal more information of a world-wide character.

Nothing is more striking in **ALEXANDER**'s paper than the divergence in the details of nursery work, both on the different estates dealt with in Hawaii itself and between these and the various countries of which notes are recorded. The manner in which pollination is effected, the collection and caring for the fertilized arrows, the thickness of the layer of fluff (the mass of hairy flowers among which the minute seeds are hidden), the medium on which it is sown and the method adopted in doing so, the size and material of the seed boxes or pots to hold the seedlings, the relative amount of exposure to the elements (sun, wind, cloud, rain), the structure of the protective seed houses or their total absence, the date of the appearance of the first and last seedlings, the time for transplanting and the number of these before the young plants are finally placed in their testing grounds, and the way in which pests and diseases are circumvented—all of these show the widest variation. And it is very difficult to arrive at any definite conclusions as to the fundamental needs of the small and delicate grass-like plantlets during their early stages. As already stated, there are indications all through that the climatic factor has the greatest influence; and in all cases abundant sunshine, air, moisture, drainage appear to be the ideal aimed at. The greatest successes have been arrived at where these conditions can be attained with the least "fussing" or "coddling," and the suspicion is aroused that there may be a good deal too much of this in certain cases. There would appear to be some remarkable inconsistencies. For instance, the hottest places appear to find it of advantage to cast aside all protection from the sun (India and Java, although Fiji uses glass "merely as a sun trap"), while the coolest places are saddled with the necessity of guarding the seedlings from scorching and wilting (Hawaii, Australia and Mauritius, the coolness of the last-named being judged by the length of time taken in germination). Leaving this point for the present, some of the differences may be mentioned, to illustrate the absence of any generally applicable methods.

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[1] W P. **ALEXANDER**. The propagation of seedling canes: notes on collection of tassels and nursery technique.
T. S. **VENKATRAMAN**. Sugar Cane Breeding at Coimbatore, India

In Hawaii comparatively thick layers of fluff ("fuzz") are sown; and there are endless troubles resulting in keeping it moist and free from moulds which are a constant menace to the young seedlings, before their delicate rootlets can penetrate the felted mass and establish themselves in the soil. In India, on the other hand, the thinnest possible layer which will cover the ground is used: no difficulty is experienced in keeping it properly moistened and the rootlets penetrate the soil with great ease: no shade is permitted, and it has even been observed that the accidental shading of the young seedlings by the high crown of a neighbouring coconut palm has marked out an area of weakly and stunted seedlings. The time taken in germination appears from the notes to vary considerably, and it is obvious that this will have much influence in keeping the young plants fit. Thus in Java, India and Fiji germination commences in three to four days, with a maximum during the first week; in British Guiana the figures given are 5-6 days; in Hawaii 4-16; in Porto Rico 6-17, and Mauritius 15. Houses are apparently universal in Hawaii; Porto Rico finds a glass house with netted sides satisfactory; Australia has glass covers or a cheese cloth, and the latter is doubled on clear days; in the Philippines glass covers are used with a piece of cloth which can be rolled up; Mauritius has glass panes over the pots; while Java, like India, apparently does without any shade. The fluff is usually spread over the surface without any covering, though in some cases the least quantity of earth or sand is spread over them. But the soil and its treatment before use vary a good deal. For example, in India equal parts of horse manure and sand are used, the former is first pitted and moistened for rotting and the destruction of grass seeds; and the mixture is placed in the pots for about a fortnight and watered for the germination of the remainder before the fluff is sown. This method has been doubtless, in the first instance, adopted because of an interesting local circumstance, namely, that an enthusiastic assistant claimed to have obtained the first cane seedlings in the early stages of experiment: but they turned out to be the seedlings of a common grass. Java and Fiji use fertile soil; while in Hawaii an apparently perfect medium has been discovered in well rotted filter-press mud. The most usual time for the first transplanting of seedlings is when they are about 6 ins. high and have the same number of leaves; but in Fiji and Porto Rico they are moved when from one to one and half inches tall and with about three leaves, and in the Philippines "as soon as they germinate." In India pots were first used for the transplanted seedlings, and, as the labour of watering proved to be excessive, groups of pots were placed in a depression, which was filled with water at stated intervals. Now pots are wholly done away with, and the seedlings are planted out close together in the ground in a first nursery; and from this transferred to a second, where they are grown until they can be cut up into sets. This method does away with much of the confusion arising, in testing, from the enormous vigour displayed by seedling canes, and from the marked differences between the external appearance and sugar content of the stalks formed early and late in the clump. In most other places pots or boxes appear to be used.

There are many other differences in the treatment of seedlings to be gathered from the incomplete records given in the two papers referred to; and it is not always clear what factors are concerned in rendering a variant practice advisable. There is no doubt that a great field for research is open as to the best method under different conditions; and as a first step, it is very desirable that a authoritative and detailed description should be prepared as to the general techniqu employed in each important centre. It is in fact not too much to say that a Manual of Cane Seedling Work is badly wanted at the present time, full details being given in every instance as to the meteorological conditions of the place where the nursery is located. To give an example of the kind of research required, one aspect of the subject has been selected in this paper for rather fuller treatment—namely, pollen fertility.

In cane seedling work selection of parents is obviously of the greatest importance. A great deal is already known regarding the general field characters of commercial varieties, although this knowledge is scattered and wants collecting and codifying. Where such information is not available steps should at once be .taken to collect it. When all is said and done, there are still a great many points to be cleared up; current reputations are far too often founded on very inadequate data. But, generally speaking, in any well-developed cane tract the standard varieties will form the most useful basis for the commencement of seedling work· As there are usually, in such a tract, a considerable number of kinds grown, it is an easy task to so combine the characters as to build up the ideal cane or canes for any special conditions—on paper. But when translated into practice a desired cross is not so easy to obtain. In other words, the study of the fertility of the male and female generative organs of the sugar cane flower, and of the seeding possibilities of the commonly cultivated varieties is still in its infancy; and no great advance is likely to take place until a biologist qualified for this special work is placed in charge and given full freedom from any other distractions. Coupled with this work it is important for a clear idea to be formed as to where the current varieties are deficient, and in what particulars it is reasonable to expect improvements by cross-fertilization. This large project, it will be seen, must form the basis of the selection of parents. ALEXANDER points out, *inter alia*, that in Hawaii H 109, Lahaina and the Tip canes form splendid material for female parents, but that there is often doubt as to their suitability as males; H 146 has specially virile pollen; Badila seldom flowers, and then the flowers are normal, while Yellow Caledonia is sterile; although it is not specified on what basis these conclusions are founded. This gives a fair idea of the kind of information required; and a very great number of observations of a similar character, often founded on exact knowledge, might doubtless be recovered from the work done in other countries. One of the first problems attacked at Coimbatore was a ready method of determining pollen fertility, leaving the question of female fertility for the nonce more to the actual results obtained after crossing. It is obvious that in canes with imperfectly developed anthers and pollen, the raising of seedlings by crossing would be a much easier and certain task, because of the ruling out of self-fertilization; and a certain number of varieties were found which possessed this character and were noted down as " good mothers."

Much labour has been devoted to the question of the viability (fertility) of sugar cane pollen in different canes. As rough and ready methods, that employed in Java was the first in the field, namely, the iodine test for starch: if a dilute solution of iodine turned the contents blue, the pollen was considered good. In India another method was devised, based on a previous study of the flowers of the pepper vine, and having the advantage that the matter could be determined by mere inspection of the stamens. This was that if the pollen sacs were seen to be well split open the pollen was viable. The examination, which could be carried out at any time, often long after the seedlings had been raised, was by rapidly passing about 200 shed anthers over the microscope stage under a low power lens; and it had the additional advantage of giving a permanent record of the *relative* fertility of the male organs in any arrow, by noting the percentages of fully opened, closed and half opened anthers: these details were taken regarding every cross made on the station. But both of these methods are merely empirical and indicative, and require confirmation by actual germination, i.e., the protrusion of the pollen tube, a piece of work of much greater delicacy, and the only true test of viability short of the raising of the seedlings themselves by actual exclusive pollination. A comprehensive trial of all published methods of procedure in pollen germination, with considerable variations in the strength and character of the solutions employed, resulted in failure at Coimbatore. Attention was then paid to the employment of the stigmas of the cane itself and of the wild *Saccharum spontaneum*; but this had to be given up because of the extremely small flowers and the abundance of pollen already in them. This delicacy also vitiated the use of the juice of the crushed stigmas of these Saccharums; and the idea was evolved of trying that of the stigmas of quite different plants. After many trials it was found that the sugar cane pollen readily germinated on the stigmas of various wild plants, and those of Datura, a common weed of the neighbourhood belonging to the Solanaceae, were ultimately selected as being specially suitable and certain. The flowers were very large and the great stigmas were coloured brightly, rendering observation easy and quick. This has become the standard practice at Coimbatore, but does not appear to have been adopted in Hawaii; for KUTSUNAI, the officer in charge of the Experiment Station there, speaks of the absence of a reliable method of testing the viability of the pollen. And this leads the writer to publish here, it is believed for the first time, a direct method which has recently been brought to his notice.

A direct method of germinating sugar cane pollen grains.—The discoverer is V. K. R. BADAMI,[1] and his permission has been obtained for publication This worker was making a comprehensive study of the germination of pollen grains among the Gramineae in Mysore, both grasses and cultivated cereals, and found that the method adopted also succeeded with the sugar cane. The pollen grains are inserted in a moist chamber under the microscope, and the only precaution of importance appears to be the regulation of the moisture in this chamber, so that it is reduced to a minimum. An ordinary glass circle half an inch in depth is fastened on to a microscope slide by Canada balsam, and on its free edge a little vaseline is rubbed. A minute fragment of filter paper, under one square millimeter in area, is moistened in water and dropped into a corner of the chamber. A dry, clean coverslip is then dusted lightly over with the pollen to be tested, inverted and pressed down on the vaseline, so as to form an air-proof box. The pollen sticks to the coverslip and does not fall into the chamber, and can be observed at leisure under the microscope. If the slightest moisture is seen to form in minute drops on the under side of the coverslip, any pollen grains near roll together and at once burst in the drop of water. The chamber is then too moist, and to remedy this the coverslip is momentarily raised from the vaseline, so that the moist air may escape, and then replaced; the protrusion of the pollen tubes then proceeds normally if the grains are viable. It may be remarked that Mysore is a dry place, and it is obvious that the experiment is more likely to succeed in extremely dry air conditions; and further, that if the method prove of general application it will do away finally with the complaint that there is no reliable method of testing the viability of the sugar cane pollen grains.

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[1] Mr. BADAMI, originally trained at the Coimbatore Agricultural College, has been lecturer on Agricultural Botany in the Mysore (India) Agricultural Department for the past dozen years; and has among other pieces of research work raised some valuable cane seedlings in that native state. He is at present prosecuting his studies as a research student in Cambridge University.

Technique in raising Cane Seedlings.

The flowering of reluctant canes has, naturally, received the closest attention all along at the Coimbatore station; and it has been found possible by appropriate cultural methods to exercise a certain amount of control. But this point is hardly germane to the particular subject under discussion. A more tantalizing difficulty has been that two desired parents may not flower at the same time, and many observations have led to the conclusion that this is an inherent character of the variety, which it is less possible to influence. The alternative method, of preserving the shed pollen, is *prima facie* out of the question; but by an indirect method a considerable measure of success has now been obtained. And the application of the method evolved by VENKATRAMAN claims not only to render it feasible to cross two varieties whose flowers open at different hours of the day, but also on different days and even in different parts of the country. As is usual in such cases the principle is a simple one, but its application is extremely ingenious. Starting with the well-known fact that spore cases are excessively sensitive to changes in the moisture of the air, and require a certain amount of dryness to cause them to split open (one may recall the old-time observation that the sporangia of ferns may be seen under the microscope to close and open by simply breathing on them), this observer has been able to keep the anthers from protrusion and dehisence by creating around them an artificial humid atmosphere. It is claimed to have been possible to keep the anthers in this latent condition, thus far, for as long as ten days, thereby opening the way for preserving the pollen within limits for a considerable period closely fastened up in its own natural receptacle, until required for application to the stigmas of the female parent.

C. A. B.

Hot-Water Treatment of Dormant and Sprouted Seed Cane.[1]

By P A YODER,

Associate Technologist, Office of Sugar Plant Investigations, Bureau of Plant Industry, Washington.

A hot-water treatment to kill insect pests (especially the moth borer and the mealybug) on seed cane has been suggested by BRANDES,[2] who found in laboratory experiments that a temperature could be chosen that was effective in killing these pests which did not kill the dormant eyes on the cane. He found, further, that the eyes were actually stimulated by this treatment. These results were verified on a larger scale by HOLLOWAY, HALEY, and INGRAM.[3] The treatment suggested by these experimenters was 20 or 30 mins. in water held at 50°C. (122°F.) and continually agitated.

In the spring of 1923 at Cairo, Ga., while the writer was working with cane that had sprouted badly in the banks, it occurred to him that this treatment, which left dormant eyes uninjured, might have a different effect upon the more tender sprouted eyes. In co-operation with J. W. INGRAM, junior entomologist, Bureau of Entomology, United States Department of Agriculture, he found that nearly all the sprouted eyes were killed by a treatment for 30 mins. at 50°C. (122°F.), and therefore serious losses must be expected where badly sprouted cane is thus treated for planting.

In September, 1923, BRANDES and KLAPHAAK[2] at Canal Point, Fla., carried out further tests with cane that, while growing in dense clumps on muck soil, had developed numerous sprouted eyes. On the basis of these tests they suggested a milder treatment of sprouted cane, consisting of preheating the cane for 20 mins. at 46°C. (114·8°F.) and then immediately heating for 10 mins. additional at 51°C. (123·8°F.). They found this treatment effective in killing the insect pests, and it was not noticeably injurious to the open-air sprouts.

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[1] U.S. Department of Agriculture, Circular No. 337, February, 1925

[2] BRANDES, E. W., and KLAPHAAK, P. J. Growth stimulation and pest and disease control by hot-water treatment of sugar cane "seed" In *Louisiana Planter*, Vol. 71, pp 371-372, 392-394, 412, illus 1923.

[3] HOLLOWAY, T. E Sugar cane insects in 1922 In *Louisiana Planter*, Vol 70, pp. 70-71 1923.

In the spring of 1924 the writer carried out at Cairo further tests with cane sprouted in the banks. Sprouted and unsprouted lots of cane of the Cayana variety (Chinese type) in cuttings from 10 to 15 ins. in length were treated in the following three ways :—

Preheating 20 mins. at 45°C. (113°F.) followed immediately by 10 mins. at 50°C. (122°F.).

Preheating 20 mins. at 46°C. (114·8°F.) followed immediately by 10 mins. at 51°C. (123·8°F.).

Heating 20 mins. at 50°C. (122°F.).

In each case the cuttings were planted within 30 to 40 mins. from the time of removal from the hot water. The soil was well pulverized at the time of planting and in fine condition as to moisture during the period of the test. The results from these tests are shown in Table I.

Table I.

EFFECT OF HOT-WATER TREATMENTS ON DORMANT AND SPROUTED SEED CANE AT CAIRO, GA., IN 1924.

No	al condit of eyes.	PREHEATING.			HIGH HEATING			Period t final observa on.	EYES.				Per cen of growing eyes	Length f sprouts
		Time	Temperature.		Time.	Temperature			Growin	Doubtf	Dead	Total		
		Min.	°C.	°F.	Min.	°C.	°F.	Days						Ins.
1	Dormant	—	—	—	20	50	122	11	46	—	4	50	92·0	0·66
		20	45	113	10	50	122	11	46	—	3	49	93·9	0·56
		(1)	(1)	(1)	(1)	(1)	(1)	11	45	—	4	49	91·3	0·44
4	Sprouted	—	—	—	20	50	122	11	20	3	27	50	40·0	—
5	,,	20	45	113	10	50	122	11	24	4	21	49	49·0	—
6	,,	20	46	114·8	10	51	123·8	11	16	2	31	49	32·7	—

The tests in 1923 by YODER and INGRAM[2] referred to above, with which the present series should be compared, indicated that practically all sprouted eyes when planted without treatment grew, and that 30 mins. treatment at 50°C. (122°F.) to 51°C. (123·8°F.) killed nearly all the sprouted eyes. The additional tests this year show that by each of these three methods of treatment of sprouted eyes a considerable number of sprouts were left alive, although in all cases more than half the sprouts were killed. The results indicate a slight preference for the milder two-heat treatment, 20 mins. at 45°C. (113°F.), followed by 10 mins. at 50°C. (122°F.), provided this is effective in killing the insect pests. The tests here recorded did not include tests of efficiency in killing the insects. The stronger two-heat treatment 20 mins. at 46°C. (114·8°F.), followed by 10 mins. at 51°C. (123·8°F.), left a smaller percentage of sprouts alive than did the one-heat treatment of 20 mins. at 50°C. (122°F.).

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[1] Not treated.

[2] YODER, P. A., and INGRAM, J. W. U.S. Dept., Agr. Cir., 303.

With reference to the stimulating effect of the hot-water treatments upon the sprouting of the dormant eyes, there is marked stimulation by both the one-heat and the milder two-heat treatments. After 11 days not only were the sprouts decidedly longer but the root system showed an even more marked stimulation. In the treated cuttings the rings of rootlets, developed in 11 days, were far more regular and more nearly complete and the rootlets decidedly longer than in the untreated lot.

Assuming any or all of these treatments to be efficient in destroying the insect pests, it appears that the method described will accomplish this result with a loss of only about one-half or two-thirds of the sprouted eyes and with a marked stimulation to growth of the dormant eyes, effective if the cane is planted immediately after the treatment. Some such method of treatment therefore has great value in keeping in check the infestation of cane plantings with moth borers, mealybugs, and other insect pests which are harboured on the seed cane. It should especially find application in planting nursery plats for future seed cane supplies and in seed cane that is to be transported from an infested to an uninfested area.

Crockett Refinery: Plant and Processes.[1]

By A. W. ALLEN.

The California & Hawaiian Sugar Refining Corporation's plant has been modified in minor details from time to time.[2] It now ranks as the largest unit of its kind in the world, with a rated capacity of 2500 tons of refined product per day. It handles 80 per cent. of the output of raw sugar from the Hawaiian Islands, the remainder going to the plant of the Western Sugar Refining Co., in San Francisco, owned by J. D. and A. B. SPRECKELS; this 80 per cent. represents the output from 33 of the plantations (these owning the refinery) the combination representing a capital of over $120,000,000. Supplies for its operation are drawn largely from local sources. Fuel oil, costing $600,000 per annum; bone char, $75,000 per annum; kieselguhr, $75,000 per annum, and chemicals, $40,000 per annum—are all Californian products. Among major expenses for sundry supplies from outside sources may be mentioned the sum of $1,000,000 or thereabouts per annum for cotton sheeting, from the South, for inner bags and $100,000 per annum for jute or burlap, from India. Freighting and insurance, for the transport of the raw and refined products to and from Crockett aggregate about $5,700,000 per annum.

Crockett is situated about 30 miles from San Francisco on the Straits of Carquinez, across which a bridge is now being constructed, and the immense refinery is familiar to trans-continental travellers who use the Southern Pacific system, the main line of which passes through the property. Water must be brought by barge and tugboat from the north shore of San Pablo Bay, 15 miles from the refinery, the supply coming by gravity to this point through pipes from Marin County. Wharfage is ample, and complete facilities are provided for the unloading of at least 16,000 tons of raw sugar per 6-day week. It operates for 12 days continuously, then shuts down for two days. This arrangement, welcomed by employees and employers alike, permits the reservation of one day in seven to all workers, and enables the mechanical department to keep the equipment in first-class condition.

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[1] *Chem. and Met. Eng.*, 1925, 352–360 (here abridged). [2] *I.S.J.*, 1921, 346, 617; 1923, 44, 268.

HANDLING RAW AND REFINED.

Constant improvement is in evidence to minimize handling costs by the maximum possible use of mechanical equipment. Formerly, the bags of incoming sugar were loaded, in lots of five, by hand on to a truck for weighing. Recently a new system was installed, whereby weighing is accurately and inexpensively performed, the tryer sample being obtained from each sixth bag. Automatic weighing, on a moving belt conveyor, is hopelessly inaccurate for the refiner of sugar, the average error being 1·5 per cent. The plan successfully adopted at Crockett involves the weighing by rapid hand adjustment of a short length of conveyor, on which six sacks of sugar are placed. The deflecting of the bags with hook to the appropriate moving platform is done so quickly, the adjustment of the scale is so rapid, and the result is so accurate, that the ideal of cheapness and efficiency appears to have been attained.

Storage for 150,000 to 175,000 tons of raw and refined sugar is available to form an adequate reserve in abnormal periods of supply and demand. A feature in the delivery system is the electric control of the conveyors and the means of inter-communication between the supply and receiving departments.

The raw sugar, 96–97·5°, is discharged from the bottom of the storage bin by drag conveyor, and then goes to two minglers, where it is incorporated with sufficient syrup to insure easy control in the centrifugals. Twenty-two Watson-Laidlaw self-discharging type machines are used, each being motor-driven at a maximum speed of 870 revs. per min. A normal load of each is about 1226 lb. of magma, as the mixture is called. The wash averages about 45 lb. per charge, the amount being controlled by a mechanically-operated device. An automatic electrically-operated baffle deflects the wash liquor into a separate channel from that taken by the syrup thrown off in the initial stages of centrifuging. The washed sugar from these primary centrifugals, averaging over 99 per cent. sucrose, is then ready for melting and refining.

FILTRATION AND DECOLORIZING.

Filtration, aided by kieselguhr, is followed by decolorizing with bone char. It was at Crockett that the pioneer work was done with the former Californian product in connexion with the purification of juices. Washed sugar from the primary centrifugals, 710 lb. per charge, falls into a melter, where sufficient hot water is added to produce a dense liquor with a moisture content of about 37 per cent. This is pumped to the top of the building and distributed to three cylindrical tanks, each 10 ft. × 10 ft. 6 in., equipped with steam coils to heat the liquor to 80° C.; the capacity of the "blow-ups" is 3800 gallons apiece, 3500 gallons being the normal load; the charge in each contains about 12 tons of sugar liquor. Kieselguhr is added in separate and distinct quantities: (1) To form a pulp by which a preliminary "smear" is obtained in the presses; and (2) to assist the filtration of the bulk of the liquor. In the former instance about 750 lb. kieselguhr is added per tank, in the latter about 75 lbs. per tank, and compressed air is used to keep the mass in agitation.

The heavier pulp, when properly mixed, is delivered by gravity to part of a battery of 38 No. 12 refinery-type Sweetland filter-presses, each with 72 leaves and a filtering area of 1044 sq. ft. The high-kieselguhr liquor is delivered by gravity to the interior of the press, the filtration cocks and manifold being open; and in 5 to 10 mins. a deposit of filter-aid is formed on the leaves. The filtration of this high-kieselguhr liquor is continued until the filtrate is clear; the cloudy effluent being returned from the press goes back to the blow-up tanks. The feed is then diverted and replaced with liquor with the smaller load of kieselguhr.

Pressure is obtained with a centrifugal pump to a maximum of about 60 lb. per sq. in. The cycle of operations in each press occupies about 2 hrs. 30 mins., after which the cylinder is drained of surplus liquor, which is pumped back to the blow-up tanks.

Two separate systems of liquor are maintained, to insure against the contamination of the high-purity liquors by the low-purity syrups. Each system has its special apparatus. The clear liquor from the high-purity Sweetlands is ready for decolorizing with bonechar. The cakes in the presses are then sluiced off with hot, low-density sweet-water, without opening the apparatus, by means of a series of arcing nozzles, the resultant kieselguhr pulp going to an equalizing tank, thence to one of four 12 ft. Oliver vacuum filters. The cake from this, after sweetening off, is pumped back to the low-purity blow-ups, where it is used once again as a filter-aid, passing to the low-purity Sweetlands, thence to the low-purity Oliver filters. The kieselguhr is therefore used twice before passing to the revivification plant. The cake formed on the drum of the Oliver filter is sprayed with water, the filtrate going to the clear sluice tank, which supplies the sluicing water for the discharge of the cake in the Sweetland presses.

The Sweetland presses have bronze-wire leaves, covered with monel-metal screens for both the high and low-purity liquors; they are opened every 8 hrs. for inspection, and, if necessary, for the thorough cleansing of the leaves by hose. The Oliver filters are equipped with monel-metal screens. 80–74 meshes to the inch. Phosphor bronze and nickel have been tried, but the metal mentioned has been found superior; while brass or bronze has replaced iron generally in the fittings of the Oliver filters. Kieselguhr being abrasive, pumps employed to convey it, as a constituent of a filter pump, are provided with high-pressure gland water service, to minimize scoring of the shaft and to protect the packing.

Bonechar decolorizing at the Crockett plant takes place in 108 char filters, each 10 ft. diam. and 25 ft. high. In all of these, the filter-cloth, of heavy cotton twill, rests on an iron plate perforated with small holes, placed about 4 in. above the bottom of the filter. The blanket is about 2 ft. larger in diameter than the tank at the point of support. The excess is available for edge packing, for which metal weights are used, held in place with wooden wedges. Fifty tons of char (minus 8 plus 24 mesh specification, weighing about 45 lb. per cub. ft. when new) is fed in to each tank with the sugar liquor, the exit valve being closed meanwhile. When the tank is full of liquor and char, the filling port is sealed, and a steady stream of liquor is delivered direct by pipe from the storage tanks on the floor above. The effluent pipe from each char filter is carried upward, so that the char is always submerged, irrespective of rate or amount of flow.

The rate of flow varies from 1250 to 2250 gall. per hour, depending on the product, the liquor remaining in contact with the char for from 1 to 4 hours. After 12 to 60 hours of service, depending on the product filtered, the char becomes impaired, indicated by a failure to decolorize satisfactorily. The filter is then drained, the syrup being returned to the filter circuit. The char is sweetened off with hot water, washed, then discharged through manholes near the bottom. The blanket is washed between each cycle, and removed for repair, if necessary. The problem of insuring an intimate mixture of char and syrup in the first instance was one that involved considerable research. As mentioned before, both are now added simultaneously, thorough wetting being effected by an ingenious arrangement of staggered funnels, placed in the neck of the filter. In view of the importance of close control of the colour of the various liquors, the correct handling of these to and from the char filters involves considerable personal attention. The liquor distribution room, where samples are continuously being taken of all inflows and effluents, is the "signal tower" as well as the "operating platform" of this part of the plant. Here the liquor from each filter is tested, returned for additional decolorizing or sent to the vacuum pans for crystallization.

KIESELGUHR REVIVIFICATION.

It is worthy of note that the practicability of the revivification of kieselguhr was first demonstrated as a result of pioneer research by the C. & H. technical staff. After double usage, the cake from the Oliver filters that handle the sluicings from the low-purity Sweetlands is passed through two revolving kilns. The first of these acts as a dryer, and the material is deprived of sufficient water to permit disintegration by a pair of rolls, placed between the two kilns. In the second kiln the temperature is raised by oil fire to about 1200 °F., whereby the activity of the kieselguhr is restored. The dust is collected by water spray, and the pulp is dewatered on an Oliver filter before being returned to the blow-up tanks.

The bonechar retorts are of the standard type, 80 forming a kiln, of which 45 are in use. The nominal output is 50 cub. ft. of char per kiln per hour. Temperature is maintained, by pyrometer control, at 500°C., as indicated at a point between the two rows of retorts on the outside. Dust is removed during passage over five Hummer screens, equipped with 70-mesh wire cloth (0·073 in.), the undersize being sold. The product of the kilns passes over a magnetic pulley before going to the screens.

Low density liquors (light sweet-water) are inspissated in a series of five Kilby evaporators, each with 1152 brass steam tubes. The flow varies from 6000 to 9000 gall. of raw material per hour, passage being continuous, through all five units in series, the first being under pressure, the last under vacuum. Concentration of the incoming liquor varies from ½ to 40° Brix., of an average of about 18° Brix.; it leaves at 67° Brix., or thereabouts. Regulation of density, and work performed in these evaporators, is controlled by steam pressure and rate of flow. The production of concentrated sweet-water varies from 35,000 to 40,000 gall. per 24 hours. This goes to the filtration and decolorizing units, then to the low-grade vacuum pans.

Fourteen single-effect vacuum pans are in service from 6 to 14 ft. diam., the load varying from 12 to 86 tons of massecuite. Eleven are of the coil type: and three are equipped with calandrias. Some of the pans are set aside for the production of low-grade sugar, which is again remelted and refined. Bronze or copper pans are used entirely for the production of fine sugar of the highest grades.

CENTRIFUGING AND DRYING.

The massecuite is drawn as required into a battery of 44 centrifugals, the regulation of wash being effected by means of an electrically operated mechanism, developed by the company's engineering department. Electric current is used to operate a relay that, at the termination of a definite number of seconds after maximum speed has been reached in the centrifugal, makes connexion which opens a water valve and allows it to remain so for a predetermined period of time. The centrifugals are discharged by a hand-operated scraper, the product, containing about 1½ per cent. moisture, going to two revolving drum dryers in series, each 6 ft. diam. and 30 ft. long. The first, locally known as the "sweater," is fitted with baffles to lift the sugar and sift it through the hot air which is provided by heater coils and a suction fan. Moisture is reduced to about 0·1 per cent. in the sweater; and to an inappreciable amount, about 0·06 per cent., by passage through the second drum, which contains a steam-heated cylinder, about

24 in diam., placed in the centre of the drum and revolving with it, against which the sugar comes in contact. The dust from the granulators is collected by water spray and returned to the evaporation circuit.

The dried product, granulated sugar, passes over an electro-magnet forming the tail pulley of a belt conveyor, then to 10 Hummer screens, each with two sieves, 3 ft × 4 ft. 9 in Three products result, known respectively as "berry," "standard" and "dust." The dust is collected by a suction system, remelted and returned to the evaporation circuit. Special 15-cycle, alternating current is provided for the vibration of the Hummer screens The finest sizes of C. & H sugar, "powdered" and "dessert," are prepared by grinding "berry" or "standard" sugar in Mead disc mills, being screened through silk cloth The coarsest product made at the Crockett plant is known as "rock crystal," followed by "confectioners' A" and "confectioners' AA," these types being produced by operations in the pan. The Hummer screens, taking the product from the granulators, produce "berry" and "standard granulated," the former being the finer grained of the two. Among the so-called brown sugars, the following varieties are prepared, "Extra C," light brown, "golden C," medium brown, and "yellow D," dark brown. These sugars are prepared in the customary manner, but from syrups that have not been decolorized completely in the char filters 'Cubes" and "cubelets" are made from a special granulated white sugar (to which is added a sufficiency of pure syrup to act as a binder) in the Hersey machine

POWER PLANT.

The power plant acts as a pressure reducing system for the steam needed for heating, evaporation and other purposes in the refinery It consists essentially of four 1500 kw Curtis turbo-generator units, of General Electric manufacture The average total load is 3900 kw, with an occasional peak load of 4200 kw About 1000 motors are in use All except those operating the Hummer screens take 60-cycle, 3-phase alternating current at 440 volts. The turbines are operated at 10 lb back pressure, any reduction below this minimum being adjusted by the addition of high-pressure steam to the main going to the plant The C & H power plant is occasionally of service to local industry in providing current in times of emergency, caused by hydro-electric shortage or accident During 1924 it was able to supply the Pacific Gas & Electric Co. with an average of 1500 kw. for several months.

The plant consists of 23 boilers, with a total rated capacity of 10,150 h p. The control of these is accomplished by the use of an automatic oil regulator, damper controllers, and feed-water regulators A CO_2 recorder and a soot blower have been installed for each boiler. The auxiliary plant consists of two 100 g.p m. turbine-driven feed pumps, two horizontal steam-driven fuel oil pumps, two 1000 g p m. motor-driven service pumps and two feed-water heaters, each with a capacity of 250,000 lb. water per hour, and two oil heaters, each of 600 sq. ft. heating surface. A feed-water treatment plant has been provided, and each set of two boilers is connected with a fuel economizer.

An intensive study of the factors affecting industrial relations has been and is being made by the company officials to remove discontent in any form, and to insure the co-operation and mutual regard that exist in the plant, which is evidenced by a low labour turnover. The company builds attractive and comfortable homes, which employees can acquire at minimum cost by small payments at regular intervals. Parks have been laid out and playgrounds built, clubhouses for men and women are available, and athletics are encouraged by the maintenance of a swimming pool, tennis courts, and a gymnasium-auditorium.

Fine Straining of Raw Juice.[1]

By D G CONKLIN.

Mechanical difficulties in the fine straining of raw juice have been overcome, so that this report will be mainly devoted to the theoretical reasons for fine straining and the subsequent effect of such straining on boiler-house work.

ADVANTAGES OF FINE STRAINING.

The H.S.P.A. Experiment Station reports as follows:—"It can be stated that if cush-cush is present when juice is limed and heated, a part of it goes into solution, adding to the impurities in the juice, with the result that the increase in purity secured during clarification is less than it would have been had no cush-cush been present. From a chemical point of view, keeping the mixed juice as free from cush-cush as possible is desirable; indeed, a more thorough screening of the juice than is the usual practice would probably be profitable. Some efforts have been made along this line, and the problem does not seem insoluble. In this connexion we would note that the fuel value of the recovered cush-cush is a considerable item. Heavy liming of the settlings, from the same point of view, is an objectionable practice, for the greater part of the cush-cush is concentrated in these settlings, and conditions are favourable for dissolving further portions of it. While it is true that, according to the indications of our experiments, the depression of the purity due to the average amount of cush-cush found in the juices does not appear to be large, a constant effect of this kind results in a loss of considerable magnitude."[2]

Increased purity.—The Station found that the effect of cush-cush elimination was to increase the purity during clarification by 0·2 per cent., and it was found in actual practice that a clarified juice of greater clarity resulted. It was noted that the volume of settlings from strained juice was lessened and that the precipitated impurities settled out more rapidly, particularly in the case of dirty cane. This made for a better capacity at the settling station. It may be possible that the advantage as regards clarification was not due so much to the removal of "cush-cush" and its soluble components as to the possibility of using more lime for clarification, utilizing the additional settling capacity derived from the removal of much of the suspended matter.

In addition to the advantage of an increase in purity during clarification, there should be an important effect on the quality and quantity of low-grade products. This cannot as yet be positively stated, due to obvious difficulty in applying abstruse effects to concrete results. However, the elimination of finely suspended matter is most certainly not deleterious to the working or exhausting of low-grade products.

Sugar in cake.—If it is found possible to reduce the cake from strained juice to the same polarization as obtained previously, the loss at this station will be materially reduced. But reports from factories using the fine strainer show that in many instances the polarization of the cake has increased appreciably, although the amount of cake was reduced about 25 per cent. This is, of course, due to the absence of the filter-aid properties of cush-cush. The characteristics of press-cake are so variable that it may well be that any alteration in its make-up will have an influence in either direction, beneficial or otherwise.

Fuel recovered.—Another result of fine straining will be additional fuel, in the form of bagasse recovered, the amount removed varying with the variety of cane being ground, the preparation of the cane before crushing, and the condition of the Messchaert grooves, scrapers, and returner bars, and also the size of the perforations of the mill strainer. Tests at various places have shown that of the total suspended matter in the raw juice, from 15 per cent. to 46 per cent. is taken out by fine screening. Assuming that the screen removes 30 per cent., it is found that with 0·50 per cent. suspended matter on mixed juice, there is removed the equivalent of 0·25 per cent. bagasse of 40 per cent. moisture, on mixed juice. It seems fair to give this removed material the value of bagasse, as it is mainly organic matter, the finest particles, such as silt and soil, being taken out to a much lesser extent.

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[1] Presented at Third Annual Meeting. Association of Hawaiian Sugar Technologists, Honolulu, October 27th, 1924 (here abridged).

[2] *Record*, Vol. XXV, p. 124.

Then, an advantage from fine straining, which is not computable in dollars and cents, is the easier cleaning of heating surfaces. With the removal of relatively large quantities of organic matter, there is less left to accumulate on the tubes of heaters and evaporators. The advantage is evident, particularly where the cane is dirty from adhering soil. But in cases where the cane is fed to the mill, as in flumed plantations, there will most likely not be a compensating advantage.

CALCULATION OF SAVINGS POSSIBLE.

Assume a factory handling 100,000 tons of juice per season. At the Hawaiian Commercial and Sugar Co's factory laboratory tests have shown that 0·4 per cent. of dry suspended matter is removed from the juice. McBRYDE gives 0·15 to 0·40 and LOS MOCHIS reports 0·3 per cent. Taking 0·3 per cent.: 100,000 tons juice at 0·3 per cent. = 300 tons dry matter. At 45 per cent. moisture, this is equivalent to 545 tons bagasse. With 1 ton bagasse equal in fuel value to a barrel of oil, at present value of oil ($1.50 per barrel), this is worth $817.

Press-cake losses.—Assuming that press-cake amounts to 2 per cent. on juice and contains 3 per cent. polarization, a reduction of 25 per cent. weight of cake with same polarization is a saving of 15 tons sucrose. Assume 80 per cent. recovery as 96 test sugar: this equals 12 tons of sugar, worth, at $80 per ton, $960.

Molasses.—Starting with a syrup of 85 purity and ending with a sugar of 96 polarization, 97 purity, and a final molasses of 38 gravity purity, assuming 12 per cent. polarization in juice, a reduction of 1° purity in the molasses corresponds to a gain of 48·35 tons 96° sugar, worth, at $80 per ton, $3868.

Syrup.—If besides the decrease in molasses purity of 1°, the syrup purity is raised 0·2 per cent., the extra recovery as 96 sugar will be 69 tons, worth $5520.

Extra expenses.—Allowance must be made for interest and depreciation on the apparatus, say at 20 per cent., $500; and replacement of the fine screen, say three times in the season, at $120, or $360. There may be an extra cost for lime; if this amounts to 25 per cent., which is extreme, the additional expense will be about $300 for this material. We then have:—

	$
Fuel value bagacillo	817
Press-cake savings as sugar	960
Sugar from lower molasses and higher syrup	5520
	$7297
Depreciation, etc.	500
New screen	360
Additional lime	300
	$1160
Possible net gain	$6137

These conditions are probably ideal and will not be realized in practice, but there is sufficient margin to warrant the trial in any factory where there is need of improvement in quality of clarification, quality of sugar, or such other operations as cleaning of heating surfaces, to which a value cannot be given with any degree of accuracy.

Influence of the Water Content of Active Carbons on their Decolorizing Power.[1]

By WERNER MECKLENBURG

Commercial decolorizing carbons (which almost always occur in fine powder) contain a greater or less amount of water. This is present as "original water," i.e., that arising during the production of the active carbon; as "added water," i.e., that was subsequently taken up by the partly or completely dried material; or again as a mixture of original and added water.

A most peculiar and at first most surprising phenomenon is the imperfect stability on drying possessed by certain active carbons, that is, the phenomenon of the decrease at increasing degrees of dryness of the decolorizing power of carbon containing original water (operating with equal weights of dry substance).

Thus, for example, active carbons under the name of *noir animal en pâte*, or the like, from France have been introduced for the purpose of decolorizing wines. They contain about 75 per cent. of water, obviously original water, and not being stable on drying, had to be sold with this high water content, that is, their activity on partial or complete desiccation was lost for the greater part, if not entirely, and was not regained on again taking up water.

Carbons which do not resist drying can be prepared from the waste char dust of sugar refineries by igniting it in the absence of air, and extracting with hydrochloric acid, the carbon left being washed with water until free from traces of the acid. Carbon thus obtained contains 80-90 per cent. of original water, and still 10 to 25 per cent. of ash (on the dry substance). It is well suited in this state for decolorizing so-called Schilcher wine, that is a wine having a bad appearance as the result of its content of red and yellow colouring substances simultaneously. As desired by the cellar-man, this carbon removes from such wines only the red, leaving a fine yellow colour. But by drying this carbon, it loses this property, if not completely, at least to a large extent, as is demonstrated by testing it against molasses, using the method described by SPÖRRY[2]. In order to obtain the same decolorizing effect against a dilute solution of molasses, one must use the following amounts of carbon (representing dry substance):—

	Made from fresh char, Mgrms.		Made from spent char, Mgrms.
Containing its original water	73	....	135
After drying at 120° C.	270	....	400

A further insight into the phenomenon was shown by different investigations carried out in this laboratory, regarding which the following may be mentioned:—

A mixture of 5 parts by weight of magnesium oxide and 1 of tar was heated for 10 minutes in an electric muffle (*a*) at 700° and (*b*) at 900° C., this product being washed with dilute sulphuric acid and with water, and tested against diluted molasses while containing its original water, and also after drying at 120° C., with the following results showing the amounts necessary to produce the same decolorizing effect under equal conditions:—

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[1] Contribution from the Central Laboratory of the Verein für chemische und metallurgische Produktion, Aussig a. E., Germany (here translated in abridged form from the *Chemiker Zeitung*, 1925, 49, No. 61, 429-430).

[2] *I.S.J.*, 1923, 434-435.

Temperature of Carbonization	With Original Water Content	After Drying at 120°C.
700°C.	62 mgrms.	116 mgrms.
800°C.	60 „	77 „

So that the carbon produced at the higher temperature suffered a much smaller loss of activity than that prepared at the lower one.

A very peculiar phenomenon is the transitory loss of activity which carbons suffer under conditions of partial drying. This occurs when a zinc chloride carbon containing its original water is submitted to partial drying in an oven at 120°C. when contained in a weighing-bottle having a constricted neck, the decolorizing power of the partially dried material being determined against diluted molasses:—

Water Content of the Carbon, per cent	Amounts of Carbon for same Effect, mgrms
80·4	80
64·5	110
34·0	140
17·3	125
8·0	110
2·8	90
—	80

This table shows that the decolorizing efficiency of the dry substance with gradual drying under the conditions stated reaches a minimum at about 40 per cent. of water, again increasing on further desiccation.

But this phenomenon by no means occurs under all conditions. It depends essentially on the way in which the carbon is dried If two portions of the carbon are dried, one in a narrow-necked weighing-bottle at 120°C. in an oven, and the second by allowing it to remain between filter-paper at ordinary room temperature, then in the first case the minimum activity is reached as described, whereas in the second the activity passes from the same initial to the same final position, but without traversing a minimum. In the following table are stated the amounts of carbon (dry substance) required for the same considerable decolorization of the molasses solution at different degrees of drying for a carbon containing original water:—

Dried in Oven at 120°C		Dried in the Air.	
Water, per cent	Carbon required, mgrms	Water, per cent	Carbon required, mgrms.
79	81	79	81
—	—	76·5	81
55·5	127	68	83
24·5	123	44·5	87
4·5	93	26·3	88
1·5	84	24·0	89
—	88	—	88

Further experiments have shown that reaching an activity minimum (as above described) is a comparatively rare phenomenon, which is exhibited only under the conditions stated, and which fails with other methods of drying, if not entirely, at least to a considerable extent. So far as it is possible to understand it at present, its cause lies in the temporary aggregation of the carbon, so that part of the capillaries is less easily penetrable.

It is therefore concluded that since the decolorizing effect of the dry substance of a carbon containing water in many cases depends on the water content, therefore it is not permissible to dry the carbon before testing its efficiency, the water content being determined on a separate portion to that used for the test just mentioned.

Cane Sugar Crop Seasons and Production.

By P. H. PARR.

It is not only of interest, but also of considerable importance to the designing engineer to have a reasonable knowledge of the relative importance of the various countries of the world as regards cane sugar production; also of the months when crushing commences, and of the duration of the campaigns, for when sending out new machinery to cane sugar countries early delivery so as to allow time for erection before the commencement of the grinding season is always of importance. Many engineers have a few rough notes on these points, but often they are far from being complete studies of the latest data.

Cuba is well known to be a very important island as regards cane sugar production, but it is by no means always fully appreciated that Cuba provides just over one-third of the total cane sugar of the whole world: this, however, is the fact, and, since practically all the sugar made in Cuba is exported, it is the reason why the Cuban crop exercises such a predominating influence on the world's sugar market.

British India occupies second position in the list of production, and furnishes well over one-sixth of the total, but as nearly all of it is made as *gur*, and all of it is consumed locally, its importance is seldom understood.

The third, and last, of the really important cane sugar countries is Java, which produces more than one-eighth of the total, most of which is exported.

It is worth noting that Cuba makes nothing but raw sugar for the refineries; British India makes *gur* (the crystal sugar produced is less than 2 per cent. of the total); and Java makes mostly "plantation whites." These three countries together provide practically two-thirds (65 per cent.) of the cane sugar of the world.

No other single country produces so much as 5 per cent. of the total; Natal and Demerara produce less than 1 per cent. each, and such places as Réunion, Jamaica, etc., do not produce even one-third of 1 per cent. each.

Taking the latest figures issued by Messrs. WILLETT & GRAY,[1] it is useful to re-arrange the countries in the order of production, and also to tabulate the relative percentages, as shown on page 372.

The 21 countries from Louisiana onwards, each producing less than 100,000 tons per year, account for only about 4½ per cent. (4·58) of the total, and a single (and comparatively small) factory in Cuba will turn out much more than the totality of the factories in a place like Jamaica. It is worth noting that 45 per cent. of the total cane sugar production of the world is at present more or less under the control of the United States of America.

At the present time, of the total sugar production of the world, 64 per cent. is cane, and 36 per cent. beet; and of the beet sugar, 87·7 per cent. is European, 11·9 per cent. U.S.A., and 0·4 per cent. Canadian.

Then considering the distribution of the cane sugar crop throughout the year, it is generally known that production goes on all the year round, in one country or another, but it is not always appreciated that 75 per cent. of the total is produced during the six months December-June, and only 25 per cent. during the other half-year.

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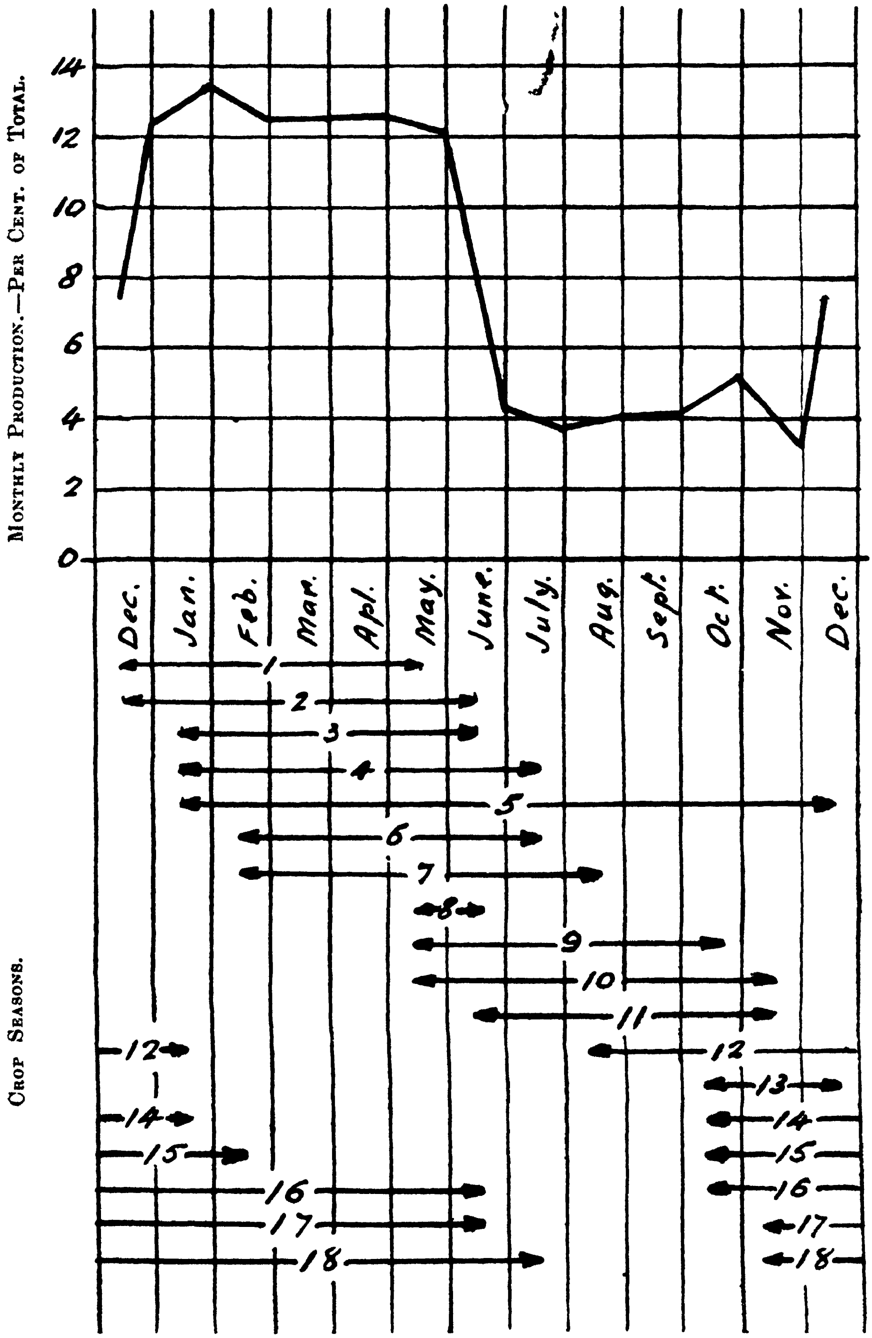
[1] *I.S.J.*, 1925, p. 287.

Cane Sugar Crop Seasons and Production.



The diagram on page 371 shows the percentage production of cane sugar during each month of the year, and also indicates the crop seasons of the various countries. The monthly production for each country has been calculated by dividing the total tonnage by the number of months, and this, although not strictly accurate, is quite near enough for all ordinary purposes, whilst exact details for each separate month are not available.

	COUNTRY	TONS.	PER CENT
1.	Cuba	4,925,000	33·87
2.	British India	2,537,000	17·45
3.	Java	1,977,490	13·60
4.	Hawaiian Islands	590,000	4·06
5.	Brazil	500,000	3·44
6.	Porto Rico	464,000	3·19
7.	Philippine Islands	462,000	3·18
8.	Formosa and Japan	460,000	3·17
9.	Australia	435,680	3·00
10.	Peru	300,000	2·06
11.	Argentina	240,000	1·65
12.	San Domingo	240,000	1·65
13.	Mauritius	221,000	1·52
14.	Mexico	165,000	1·14
15.	Natal	144,196	0·99
16.	Egypt	110,000	0·76
17.	Demerara	100,000	0·69
18.	Louisiana	93,953	0·65
19.	Fiji Islands	70,000	0·48
20.	Sundry Central America	65,000	0·45
21.	Mozambique	55,000	0·38
22.	Barbados	53,000	0·36
23.	Trinidad	50,000	0·34
24.	Réunion	43,500	0·30
25.	Jamaica	42,600	0·29
26.	Guadeloupe	34,000	0·23
27.	Guatemala	24,000	0·17
28.	Martinique	23,000	0·16
29.	Venezuela	19,000	0·13
30.	Ecuador	18,700	0·13
31.	St. Kitts	16,000	0·11
32.	Antigua	14,500	0·10
33.	Spain	10,629	0·07
34.	Surinam	10,200	0·07
35.	Sundry British West Indies	9,000	0·06
36.	Virginia Islands	7,200	0·05
37.	Haiti	7,000	0·05
38.	Texas	450	0·00

For the crop seasons, as indicated on the figure, the countries involved are as follows:—

1.	Dec.-May	British India.
2.	Dec.-June	Cuba, Spain, Haiti, Mexico.
3.	Jan.-June	Porto Rico, Virgin Islands, Trinidad, Barbados, Jamaica, sundry B.W.I., San Domingo, Guatemala, sundry Central America, Egypt.
4.	Jan.-July	Martinique, Guadeloupe.
5.	Jan.-Dec.	Peru.
6.	Feb.-July	Antigua.
7.	Feb.-Aug.	St. Kitts.
8.	May-June	Demerara (see No. 13).
9.	May-Oct.	Natal, Mozambique.
10.	May-Nov.	Argentina, Java.
11.	June-Nov.	Australia, Fiji Islands.
12.	Aug.-Jan.	Mauritius, Réunion.
13.	Oct.-Dec.	Demerara (see No. 8).
14.	Oct.-Jan.	Louisiana, Texas, Surinam.
15.	Oct.-Feb.	Ecuador, Brazil.
16.	Oct.-June	Venezuela.
17.	Nov.-June	Formosa and Japan, Philippine Islands.
18.	Nov.-July	Hawaiian Islands.

Demerara, it will be noted, has the interesting peculiarity of having two crops, though both are quite short.

The 1924 Java Sugar Crop.

By R. J. PRINSEN GEERLIGS

During 1924, 179 sugar factories (the same as in 1923) were active in Java. Kedoengbanteng ground for the first time, and Ponggok was at work again, while Banjoepoetih and Tirto were shut down.

The sugar estates planted and harvested an area of 172,311 hectares (or 424,945 acres) against 162,481 hectares (or 401,485 acres) in 1923. The total amount of cane harvested was 18,029,702 tons[1] or 42·36 tons to the acre. The total sugar crop amounted to 1,966,237 tons or 10,326 lbs. to the acre.

The figures for the different residencies and the totals and averages in tons, pounds, acres, etc., as given below, are calculated after the data published by Mr. J. VAN HARREVELD in the *Archief voor de Java Suikerindustrie.*[2]

The 1924 season proved a very good one, surpassing that of 1917; it had a production of sugar to the acre of 10,326 lbs., as compared with 10,117 lbs. in 1917. The total outturn exceeded to a considerable extent the first estimates, as can be seen in the following figures supplied by the United Java Sugar Producers. These estimates, expressed in piculs of 136·16 lbs., were as follows at the dates indicated :—

Date	Estimate Piculs
31st May	26,906,000
30th June	27,202,000
31st July	27,955,000
31st August	28,557,000
30th September	28,910,000
31st October	28,989,000
Final result	29,004,000

The average tonnage of cane amounted to 42·36 tons to the acre, which approaches that of the year 1917 when a record production of 43·09 tons to the acre was achieved. In 1924 the residency of Kedoe reported the largest figure, followed by Banjoemas, while Cheribon was lowest in this respect with only 39·83 tons of cane to the acre.

The sugar content of the cane was good, allowing an average sugar extraction of 10·88 per cent. The highest extraction was attained in the residency of Djocdjakarta with 11·93 and the lowest in that of Banjoemas with 10·18 per cent.

The highest average yield of sugar to the acre is reported from the residency of Djocdjakarta with 11,249 lbs. and the lowest from Semarang with 9627 lbs.

The maximum figure for one single factory was witnessed in the residency of Soerabaja, where Ketegan estate scored the highest output of sugar to the acre with 16,097 lbs.

In studying the list of cane varieties planted, it will be seen that there is again a decrease in the use of the older sorts, B 247 and POJ 100, while the newer kinds, EK 28 and DI 52, are steadily increasing. The distribution of the other sorts among the plantations remains comparatively unchanged.

The total sugar crop amounted to 1,966,237 tons, of which 1,924,942 tons were first sugars and the balance consisted of after-products, calculated back to the equivalent of first runnings at the ratio of 4 : 3. The figure in the second column of Table III refers, however, to the real weight. Besides the sugar a quantity of 82,504 tons of solidified molasses was manufactured and exported.

We also give here the data relating to the total sales of Java sugar and the portion sold by the United Java Sugar Producers, which body, according to these figures, disposed of 89·1 per cent. of the total Java crop of the year 1924.

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[1] Tons of 2240 lbs

[2] Mededeelingen van het Proefstation voor de Java Suckerindustrie, 1925, No 3.

Assortment.	Total Sales Piculs.	Sales by U J.S.P. Piculs.
Superior "head" sugar	17,612,128	16,400,342
Superior soft sugar	318,944	289,008
Channel assortment, 98 pol.	8,309,250	7,165,216
Raw sugar, 96·5 pol.	5,426,539	4,742,832
Molasses sugar	825,839	395,550
Sack sugar	61,797	9,554
Total sales	32,554,497	29,002,502

All these figures represent piculs of 61·76 kg. or 136·16 lbs.

The United Java Sugar Producers began their sales of the 1924 crop in March, 1923, at the price of 15 guilders per picul for the whites and 14 for the raws, and ended in October, 1924, at the price of 13 guilders for the raws, with top prices in May, 1923, of 16·50 guilders per picul for the whites and 15·50 guilders for the raws. The total crop was disposed of at an average price of 15·07 guilders per picul of whites, 13·75 for the picul of refining crystals, basis 98° polarization and 13·51 for the sugar basis 96·5° polarization.

The consumption in the territory of the Dutch East Indies may be put at 150,000 tons or 2,400,000 piculs, while the balance is disposable for export.

The destination of the exportation from the 1924 sugar crop has been the following in tons of 2240 lbs.; and we give the corresponding figures for a few previous years as a comparison. The stocks of sugar still existing at the beginning of the 1924 grinding season are estimated at about 22,300 tons, and on April 30th, 1925, there were none left.

I —Cane Crop.

Residencies and Totals	Number of Factories in Operation	Land under Cane.		Cane Harvested		
		Hectares	Acres	Tons	Tons per acre	Kilograms per Hectare
Cheribon	12	10,633	26,222	1,046,695	39 83	100,003
Pekalongan	17	17,224	42,476	1,807,468	42 81	107,488
Banjoemas	5	5,619	13,858	643,037	46 31	116,279
Kedoe	2	4,142	10,214	492,140	48.08	120,717
Djokdjakarta	17	16,381	40,398	1,705,837	42.12	105,747
Soerakarta	16	16,412	40,474	1,627,405	40 11	100,699
Semarang	11	10,393	25,630	1,083,432	42 19	105,921
Madioen	6	7,412	18,278	778,901	42.53	106,792
Kediri	21	23,509	57,977	2,540,087	43 61	109,751
Soerabaja	36	28,040	69,153	2,993,495	43.19	108,445
Pasoeroean	27	25,874	63,810	2,599,277	40.66	102,092
Besoeki	9	6,672	16,455	711,943	43.16	108,358
Total **1924**	**179**	**172,311**	**424,945**	**18,029,702**	**42.36**	**106,357**
„ 1923	179	162,481	401,485	16,078,051	40 04	99,986
„ 1922	182	160,908	397,443	16,759,106	42.05	105,816
„ 1921	183	159,474	394,060	14,939,679	37.89	95,125
„ 1920	183	156,069	385,647	14,398,238	37.34	93,732
„ 1919	179	137,655	340,138	13,075,128	38.10	96,517
„ 1918	186	163,071	402,943	15,637,342	38.44	97,387
„ 1917	185	160,439	396,440	17,079,303	43.09	108,179
„ 1916	186	155,165	385,290	15,878,300	41.11	103,218
„ 1915	186	151,165	373,500	14,189,000	37.97	96,385
„ 1914	186	147,465	366,000	14,901,000	40.87	102,000

The 1924 Java Sugar Crop.

II.—SUGAR EXTRACTED.

Residencies and Averages	Kilograms per hectare.	Lbs. per acre	On 100 Cane	Yearly maximum output of any single factory. Kilograms per hectare.	Lbs. per acre
Cheribon	10,972	9,782	10.97	14,144	12,616
Pekalongan	11,756	10,480	10.93	14,621	13,447
Banjoemas	11,843	10,559	10.18	14,102	12,578
Kedoe	12,452	11,101	10.31	12,794	11,413
Djokdjakarta	12,627	11,249	11.93	16,014	14,287
Soerakarta	11,582	10,326	11.50	15,187	13,548
Semarang	10,798	9,627	10.19	13,185	11,762
Madioen	11,756	10,480	11.00	13,055	11,646
Kediri	11,843	10,559	10.79	14,186	12,656
Soerabaja	11,669	10,404	10.75	18,015	16,097
Pasoerocan	11,059	9,860	10.83	15,753	14,054
Besoeki	11,059	9,860	10.20	13,751	12,266
Average, **1924**	**11,582**	**10,326**	**10.88**	**18,015**	**16,097**
,, 1923	10,965	9,784	10.97	16,362	14,480
,, 1922	11,226	9,950	10.61	16,362	14,480
,, 1921	10,517	9,321	11.04	17,911	15,875
,, 1920	9,892	8,826	10.55	15,178	13,540
,, 1919	9,706	8,657	10.06	14,639	12,957
,, 1918	10,904	9,723	11.19	15,996	14,265
,, 1917	11,382	10,117	10.50	16,415	14,696
,, 1916	10,355	9,238	10.03	15,300	13,650
,, 1915	8,729	7,788	9.15	12,941	11,546
,, 1914	9,526	8,495	9.28	14,125	12,602

III.—SUGAR PRODUCTION IN TONS

Residencies and Totals	First Sugars	After Products	Total Production: After products as 1 3	Solidified Molasses
Cheribon	113,929	1,501	115,054	2,204
Pekalongan	195,388	5,283	199,372	15,409
Banjoemas	65,411	135	65,513	824
Kedoe	50,598	218	50,759	5,932
Djokdjakarta	202,184	1,858	203,576	—
Soerakarta	185,566	1,104	186,394	—
Semarang	107,871	2,820	110,446	4,193
Madioen	84,661	1,273	85,615	3,255
Kediri	265,597	10,612	273,556	17,684
Soerabaja	317,064	6,789	322,155	21,524
Pasoerocan	265,931	20,113	281,015	10,187
Besoeki	70,742	2,721	72,782	1,292
Total, **1924**	**1,924,942**	**54,427**	**1,966,237**	**82,504**
,, 1923	**1,740,895**	**31,655**	**1,764,636**	**103,842**
,, 1922	**1,749,640**	**39,609**	**1,779,557**	**62,125**
,, 1921	**1,632,067**	**34,620**	**1,658,032**	**74,892**
,, 1920	**1,497,244**	**30,060**	**1,519,562**	**164,459**
,, 1919	**1,297,320**	**23,977**	**1,315,158**	**96,303**
,, 1918	**1,714,833**	**101,922**	**1,750,197**	**18,511**
,, 1917	**1,779,654**	**22,682**	**1,793,415**	**49,870**
,, 1916	**1,579,670**	**32,300**	**1,604,154**	**85,749**
,, 1915	**1,273,190**	**35,312**	**1,298,307**	**127,543**
,, 1914	**1,305,246**	**100,061**	**1,382,825**	**94,765**

IV.—SUBDIVISION OF THE CROPS IN PERCENTAGES ACCORDING TO ASSORTMENTS.

Residencies and Averages.	White Plantation Sugar. First running.	White Plantation Sugar. Second running.	Channel Assortment Refining Crystals, 98° pol.	Refining Crystals, 96.5° pol.	After-products.	Total.
Cheribon	62.7	2.0	15.6	18.5	1.2	100
Pekalongan	65.8	3.8	16.0	12.2	2.2	100
Banjoemas	—	—	56.8	42.9	0.3	100
Kedoe	—	—	70.1	29.5	0.4	100
Djokdjakarta	72.7	2.0	14.5	10.0	0.8	100
Soerakarta	89 1	—	10.3	—	0 6	100
Semarang	41.2	1.6	35.2	19.5	2.5	100
Madioen	84.1	—	14.0	—	1.9	100
Kediri	63 8	—	21.3	11.9	3.0	100
Soerabaja	60.5	1.0	23.2	13.4	1.9	100
Pasoeroean	23 3	—	42.2	29.0	5.5	100
Besoeki	—	—	40.7	56.4	2.9	100
Average, 1924	**54.45**	**0.99**	**25.69**	**16.78**	**2.09**	**100**
„ 1923	53.11	1.06	28 91	15.20	1.72	100
„ 1922	52.85	1.53	27.45	16.46	1.71	100
„ 1921	53.42	0.12	28,05	15 33	3.08	100
„ 1920	51.71	0.83	30.41	15.08	1.97	100
„ 1919	49.7	2.1	23.1	23.3	1.8	100
„ 1918	45 9	3.2	27.0	21.0	2.9	100
„ 1917	50 3	1.9	40.6	6 2	1 0	100
„ 1916	48.1	2.9	37.3	9.7	2 9	100
„ 1915	43.8	4 2	34.9	14 1	3.0	100
„ 1914	40.3	4 0	32 3	15.7	7.7	100

V.—PERCENTAGE COMPOSITION OF THE CANE PLANTINGS OF—

VARIETY	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
B. 247	58	57	54	48	41	29	26	20½	17¼	15½	12½
P.O.J. 100	29	30	30	31	28	16	10	6½	4	2¾	1½
Cheribon	6	5	5	4	3	1	1	½	—	—	—
P.O.J. 213	1	1	1	1	1	—	—	½	—	—	—
E.K. 2	1	1	2	4	4	6	6	6½	6½	6	6¼
E.K. 28	—	—	—	2	6	23	32	39	39	40	43½
F. 90	—	—	1	2	4	4	3	3	3¼	3	3
D.I. 52	—	—	—	1	4	13	14	15	18½	21½	22½
Tjep 24	—	—	—	—	2	1	1	1	—	—	—
S.W. 3	—	—	—	—	1	1	2	2	2½	2¾	3
P.O.J. 2714	—	—	—	—	—	—	—	—	2	2¾	2¼
P.O.J. 2725	—	—	—	—	—	—	—	—	1½	1	½
Various	5	6	7	7	6	6	5	5½	5½	4¾	5
Total	100	100	100	100	100	100	100	100	100	100	100

The 1924 Java Sugar Crop.

EXPORTATION OF JAVA SUGAR.

DESTINATION	1919/20	1920/21	1921/22	1922/23	1923/24	1924/25
Netherlands	21,283	9,804	10,222	32,528	7,473	18,419
Belgium	—	7,396	—	2,702	5,694	12,437
United Kingdom ...	119,528	50,642	9,124	102,069	231,338	79,212
France	41,636	10,013	10,124	83,957	83,768	99,757
Germany	—	—	104	13,023	61	2,561
Russia and Finland	1,414	10,922	4,000	11,261	—	33,384
Denmark	2,370	—	681	26	—	—
Sweden . .	14,522	27,807	—	—	6,007	10
Norway ...	50,152	31,008	—	2,322	851	2,437
Italy	45,956	18,166	33,502	8,865	6,639	4,323
Portugal ..	—	1,000	—	—	—	2,202
Spain	6,919	3,004	—	—	—	—
Greece.. . .	8,239	5,907	5,875	9,610	16,949	15,631
Rumania ...	3,921	3,070	3,756	—	—	—
Servia ...	—	—	951	2,256	—	—
Turkey . .	23,231	2,174	9,049	11,664	2,582	1,247
Port Said, etc., f.o.	67,124	365,473	61,454	159,043	151,298	134,754
Smyrna .	—	—	—	5,498	—	892
United States	—	237,162	300	—	23,457	726
Vancouver . .	2,953	—	5,020	7,000	12,319	21,925
Arabia .	—	—	—	—	50	863
British India	336,000	212,562	625,909	440,538	413,784	536,614
Aden	—	—	—	—	981	2,702
Penang ..	—	—	—	—	11,548	16,729
Singapore ..	64,568	41,450	70,041	60,780	55,496	73,594
Saigon. . ..	—	—	—	—	4,005	—
Siam	3,428	2,358	3,565	17,650	11,484	19,075
Dairen .	—	—	—	—	3,981	13,893
China . ..	3,525	3,765	32,638	30,751	19,141	79,032
Hong Kong	184,422	171,398	319,126	258,513	245,279	303,489
Japan and Formosa ..	272,187	94,473	353,787	279,883	280,302	329,173
Australia	82,718	63,362	5,447	4,435	263	3,186
New Zealand . . .	—	—	—	—	17,741	6 972
Other Countries .	3,152	644	20	2,802	2,255	—
Total	1,359,348	1,373,560	1,564,695	1,547,176	1,614,746	1,815,239

The Farrel Foundry & Machine Company, of Ansonia, U.S.A., recently announced that they had concluded arrangements with Enrique Abarea & U. Casal, of San Juan, Porto Rico, whereby the latter firm will represent them in the territory comprising Porto Rico, Santo Domingo, and St Croix, Virgin Islands. This step has been taken in order to give closer co-operation and a better service to present and prospective users of Farrel equipment, and to facilitate dealings between these customers and the home office of the Farrel Foundry & Machine Company.

The engineering industry in Great Britain is as a whole in a depressingly quiet condition, but some sections are in a more fortunate position than others, the sugar machinery trade being a case in point. Not only are several firms well occupied with equipment for new beet sugar factories, but orders for cane sugar machinery for overseas destinations are by no means scarce. **BLAIR, CAMPBELL & McLEAN, LTD.** (of Glasgow), for instance, have in hand an 11-roller, a 5-roller and a 3-roller milling plant, a number of crushers, a triple with vessels 11 ft. in diam., several vacuum pans, centrifugals, dryers, and a battery of crystallizers.

Mr. G. S. W. MARLOW, Assistant Secretary of the Institute of Chemistry, London, and a Barrister-at-Law, has compiled a most useful pamphlet entitled "Notes on Contracts of Service,"[1] which is supplementary to Mr Macgillivray's recent lecture on "Some Aspects of the Law of England as affecting Chemists." Before signing their agreements, most chemists would do well to be familiar with the points made clear in these "Notes," in particular with points such as: Essential of a Contract; Particulars to be stated; Property in Improvements or Inventions; Termination of Breach of Contract; and Remedy for Breach of Contract.

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[1] Published by the Institute of Chemistry of Great Britain and Ireland, 30, Russell Square, London, W.C.1, addressing communications to the Registrar.

Cane Loaders.[1]

By B. W. MACKIE.

The most practical device used in loading cane into cars in the field has proved to be a full revolving crane, or derrick, mounted on a tractor base of the crawler or continuous tread type. The cane is bundled or piled on to a pair of single slings lying on the field, and the bundles lifted by the crane, swung around to the car and dropped. The slings are removed after being unhooked, and pulled free from the bundle by means of the crane.

The machine itself consists essentially of a tractor or crawler base, on which are grouped the travelling and steering mechanisms controlled by the operator from the operating platform on the rotating base. The rotating base, mounted on the tractor base, contains the power plant, hoisting and swinging mechanisms, the control levers, and a boom approximately 40 ft. long, capable of being raised or lowered as desired.

In getting over the fields it is important that the machine has sufficient effective length and breadth supporting it, so that it will be stable. 10 ft. × 10 ft. seems to be about the accepted size. Taking this as a basis from which to build a strong and rugged machine, it is found that the total weight will be somewhere between 20 and 25 tons. To move this weight over the field with as little damage as possible, the crawler type tread must have sufficient supporting surface to distribute the total weight over a large area. The bearing pressure on the ground should not exceed 10 lbs. to the sq. in.

Cane loaders of this type are not limited to just this one class of work, as they may be used for operating a clamshell bucket, dragline scraper bucket, hook block, pile driver hammer, electric lift magnet, etc. Nearly every type made may be converted into a power shovel, by taking off the crane boom and substituting a boom having the proper equipment for this work. The machine can then be used for the same work where a steam shovel would be employed.

ESSENTIAL MACHINE PARTS.

Power Plant.—The power plant of a cane loading crane usually consists of a heavy duty tractor type gasoline engine having four cylinders. It should develop sufficient power at a normal speed to drive the machine anywhere it would be expected to work. All its parts must be built rugged and strong, with special reference to accessibility and perfect lubrication. It is important that an air cleaner be installed ahead of the carburetter to insure against grit and dirt entering the engine. A clutch should be installed between the engine and operating mechanism so that all gears and shafts may be stopped with the engine still running. The power plant should be mounted on the main frame in such a manner that all strains are not directly transmitted to the engine base. The drive to the reduction gears should be as flexible as possible. An efficient cooling system is imperative.

Drive from power plant.—Because of the fact that a gasoline engine develops its power at a relatively high speed, a means of reducing this speed to that required for hoisting, swinging, and travelling, must be employed. This reduction is accomplished usually by gears. Special attention should be paid to securing a drive which will give perfect service in operation.

Rotating mechanism.—The rotating frame is swung to right or left by a pinion engaging in a ring gear fastened to the travel base. The rotating pinion, through a series of reductions, receives its power from a reversing shaft driven from the reducing gears. Where only one reversing shaft is employed, a jaw clutch is mounted on the rotating shaft so that it may be disengaged, and the reversing shaft used for travelling. There is no necessity in this work to perform swinging and travelling simultaneously, so the use of two separate sets of reversing clutches is done away with. One set, through selective jaw clutches, enables the operator to handle the machine under all operating requirements. Simplicity of design and accessibility for repairs are important.

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[1] Presented at the Third Annual Meeting of Association of Hawaiian Sugar Technologists, Honolulu, October 27th, 1924.

Hoisting mechanism.—The hoisting mechanism consists of drums independently driven by friction clutches, loosely mounted on shafting driven from the reduction gears. Where both drums are mounted on one shaft, the design is simplified by the elimination of a shaft, bearings and a gear, and makes other assemblies easier to get at. It is necessary to see that the drums be of sufficient size to properly coil the 200 ft. of 1¼ in. cable, commonly used for hoisting.

The propelling mechanism.—This drive is taxed with the hardest service at all times. It must be rugged and contain the least number of pinions, gears, and shafts possible. It must be constructed so that repairs in the field can be readily made. The drive is taken from the reversing clutches, through several gear reductions and the centre pin of the machine, to the travel base, and finally to the crawler treads themselves. The final drive to the treads is either through gears or a roller chain. The chain drive is the most flexible and easiest to repair, and in addition gives adjustment of the tread belt at either end of the travel base.

Rotating base.—The main rotating member is called upon to withstand severe shocks due to travelling over uneven footing, ditches, etc., and is preferably made of a solid annealed steel casting, from which the supports for the main machinery are built up.

Travel base.—The travel base, which must be built very rugged and strong, consists of a heavy main casting, preferably steel, the supporting axles or beams for the crawler treads and the ring gear securely attached to the casting. Avoid any machines that have built-up structural bases for the main parts of either the rotating or travelling bases.

Centre pin.—The travel base and rotating base are tied together by means of a hollow steel gudgeon or centre pin, which must be of the best material obtainable and heavy enough to afford a good margin of safety. There must be provided a convenient means for taking up wear at this point of the machine.

Treads.—There are many types of crawler mechanisms, but the ones that most closely follow approved tractor ideas will be found to be most satisfactory.

General.—It is, of course, highly important that workmanship and careful design enter into a machine of this nature, to insure the greatest degree of service. Interchangeability of parts is also an important feature. Levers and controls must be placed so that all operations can be conveniently performed by the operator from his platform. Proper lubrication of all bearings is essential to insure long life and continued service. The use of frictionless bearings on high speed shafts and gears is to be recommended. Placing the operator so that he commands an unobstructed view on all sides and providing controls that will operate with the least physical effort, will make it possible to perform the greatest amount of work. Adjustments must be provided at all points in the controls to compensate for wear.

CANE FIELD CONDITIONS FROM THE STANDPOINT OF MACHINES.

Travelling.—Cane loaders in the field are subject to the hardest kind of service, in that they are moving from car to car a great percentage of the time, under unfavourable ground conditions. Furrows, irrigation ditches, and water course ditches, encountered at all times, necessitate a strongly built foundation, and only the best construction will endure. It is important that the machines go over the fields with as little disturbance as possible, and with dispatch. Quite frequently the machines are called upon to work on a grade, and some form of brake on the travel mechanisms is required, or they must be blocked to prevent rolling down grade.

The longer the effective surface of the crawler mechanism on the ground, the more stable will the machine be. A short crawler tread will, in effect, give a rocking-horse motion to the machine when travelling across the field. As the field furrows are 5 ft. or more centre to centre, it will be seen that about 10 ft. of tread length is desirable.

The treads and driving parts should be so designed as to pick up as little cane trash and refuse lying on the field as possible. This is especially important in wet weather operations.

Careful handling and well-planned setting of the correct number of cars for the amount of bundles to be loaded is essential to satisfactory performance. Requiring the machine to go back over a section already "taken off" to load a few cars can be laid only to bad field management, and works a hardship on the machines because the time taken up in travelling cuts down the total number of cars that can be loaded in one day. Wherever possible, it is advisable to load cane only from the side of the cars on which the machines are travelling.

Steering.—Field conditions demand that when turning and steering, the machines do as little damage to the furrows and ratoons as possible. To handle properly they must steer positively to right or left when travelling in either direction, and at the easy command of the operator. A thoroughly successful and practical steering device controlled from the rotating base of the machines is, of course, a necessity. Many machines have a crude and unsatisfactory steering device.

Lifting.—All the present machines used in this service have been designed for much heavier work than they are called upon to do in loading cane, so there is a good margin of safety in the hoisting mechanism, and very little trouble, if any, is encountered. A good boom-head construction, for guiding the cable with a minimum of wear, is essential. Also, it is important that the cable wind up properly on the drum with as little attention from the operator as is consistent.

Swinging.—It should be the aim of the operators to keep their machines as level as possible when loading cane, so that they will swing easily. This is not always practicable in service, so that a powerful, yet easy working, swinging mechanism should be incorporated in the construction. To stop the swinging of the machine, the reversing clutches are thrown in, in the opposite direction, and this should be done in such a manner that the motion is not stopped immediately. After getting the load in motion it should be permitted to coast and be brought to a gradual stop. Gauging the position of the machine with reference to the car to be loaded assists greatly in smooth handling.

Conclusion.—The commercial success of the jib crane type of cane loader has been assured by the past season's use at the Oahu Sugar Co., Waipahu ; Kahuku Plantation Co., Kahuku ; Honolulu Plantation Co., Aiea ; The Hawaiian Sugar Co., Makaweli ; and Lihue Plantation Co., Lihue. The machines unquestionably relieve the severest manual work on the plantations, and if for no other reason, they are a step in the right direction. The mechanical loaders enable the plantations using them to harvest the cane faster than by hand methods. The use of them assures a train load of cane at the mill earlier in the day. Cane may be bundled in the field whether cars are placed or not, and the cars are kept in actual load hauling a greater percentage of the time.

Measurement of the Turbidity of Cane Juices.[1]

By WALTER E SMITH

In view of the interest in turbidity measurement, some study was made of the various methods available, such as the Kopke turbidimeter,[2] and the obervation of carbon lamp filaments, candle flames and cross lines on translucent paper through a column of liquid in a cylinder

Standard solutions were prepared by colouring distilled water with caramel and adding varying quantities of a kieselguhr suspension Ten grams of kieselguhr in 1000 c c of distilled water was used as the standard suspension, and varying volumes of this mixture were made up to 300 c c together with appropriate volumes of the caramel solution For convenience, these solutions may be numbered 1, 2, 3 and 4, the first contained only the kieselguhr suspension and no caramel, while the last approximated the colour of the darkest clarified juice ever likely to be encountered

KOPKE TURBIDIMETER

Using these artificial suspensions, the following results were obtained with the Kopke turbidimeter —

	10 c c Kieselguhr Suspension in 300 c c	5 c c Kieselguhr Suspension in 300 c c
Solution No 1 (no colour)	4 0	6 8
2	3 9	6 7
3	3 8	6 3
4	3 6	6 0

While the effect of colour is distinctly noticeable, giving an appreciable difference between the extremes, it seems likely that the difference with the colour actually encountered when working with clarified juice would ordinarily be small

NESSLER TUBE METHOD

A Nessler tube was so arranged that a filament of a light globe could be observed through a column of juice, the cylinder was covered with black paper to exclude outside light The following results were secured, the figures indicating the number of cubic centimetres of juice in the cylinder at the end point —

Solution No 1	69
2	68
3	67
4	66

The effect of colour is not so noticeable as with the Kopke turbidimeter Considerable fluctuation in the intensity of light, brought about by introducing varying resistance, did not affect the observation to a greater extent than the normal experimental error

When cross-lines were ruled on translucent paper, and placed between the light source and the bottom of the cylinder, the results were consistent and capable of accurate duplication, though the readings were much lower than with the direct observation of the lamp filament. Changes in the intensity of the light had little noticeable effect

In general, methods based on the observation of a lamp filament might be slightly more accurate than the Kopke turbidimeter, though the latter is probably more practicable as a general method to be used under a wide variety of conditions

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[1] Paper presented at Third Annual Meeting of Association of Hawaiian Sugar Technologists Honolulu October 27th, 1924 (here abridged)

[2] *I S J*, 1924, 324

DETAILS USING THE KOPKE TURBIDIMETER.

Observations should be made close to a window where there is a uniform illumination, away from overhead lighting and never in direct sunlight. The turbidimeter should be held so that the tube is vertical, with the plate touching the side of the cylinder nearest the source of light. The cylinder used should always be clear, as a stained or dirty container will vary the intensity of illumination.

The end point is reached when the cross-lines on the porcelain plate just disappear from sight, but can again be seen by only a slight raising of the plate. At this point, the finger should be placed firmly over the upper end of the tube, so that no solution is allowed to run out. Litharge and glycerine mixed to a paste forms a good cement tube and plate when using hot liquids.

For observation at night, a 60—75-watt lamp fixed about 18 inches from the cylinder containing the sample, and about 6 to 8 inches above the surface of the liquid, will give readings which are in close agreement with daylight observations. The exact position of the lamp can be readily determined by making observations in daylight and adjusting the lamp to the point at which similar readings are obtained. The polariscope hood makes a convenient place for this observation at night.

Recent Work on Clarification in Hawaii.[1]

By W. R. McALLEP.

CHARACTERISTICS OF HOT CLARIFIED JUICE.

Work was undertaken by Mr. BOMONTI to obtain definite information based on direct experiment on the changes taking place in juice held at high temperatures, that is, from the time it passes through the heaters until lower temperatures are encountered in the evaporators. It has been pointed out that inversion of sucrose was definitely demonstrated in juices initially slightly alkaline, but could not be detected at higher alkalinities. Also that, though glucose was destroyed during clarification at alkaline reactions, further destruction was not detected during the digestion of the juice at high temperatures.

One of the most important factors with which we have to deal with in factory operation is development of acidity, particularly that taking place at temperatures too high for the development of bacteria. In addition to development of acidity due to bacterial action, development of acidity takes place in two ways which bear little relation to each other: (1) An increase in the total amount of products of an acid nature; (2) an increase in the activity of the acid.

In these experiments an increase in the amount of acid products was measured by titration with phenolphthalein and litmus. On the basis of phenolphthalein titration, increases in the quantity of acid products proceeded at about the same velocity in alkaline and acid juices. On the basis of litmus titration, there was somewhat of a tendency for it to proceed more rapidly in the more alkaline juices. With both indicators an increase in the quantity of acid products took place much more rapidly as temperatures were increased.

HYDROGEN-ION CONCENTRATION.

The hydrogen-ion concentration (the activity of the acid), is of much greater importance in sugar factory practice than the quantity. On the basis of activity, development of acidity at a given temperature proceeds very slowly in the more alkaline juices. In the more acid juices, development of acidity is many times as fast. Also on the basis of activity the development of acidity becomes much faster as temperatures are increased.

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[1] Paper presented at Third Annual Meeting of Association of Hawaiian Sugar Technologists, Honolulu, October 27th, 1924 (here abridged).

It has been the general opinion in factory practice that alkaline juices become acid faster than acid ones. Perhaps this is partly due to the fact that litmus has been the indicator commonly used. But, in the light of data secured during this investigation, this theory is quite contrary to the actual facts, at least so far as the really significant factor, hydrogen-ion concentration, is concerned, and within the range of reactions practicable in sugar factory operation.

We have little information on the nature of development of acidity further than that it is a factor of time, temperature, and reaction of the juice. It has been ascribed to the destructive action of lime on "glucose," but available data strongly indicate that this cannot be a major factor. It has been noted, for example, in the canning industry, where no alkali has been added; and is probably a characteristic of most, if not all, plant juices. Oils also show a similar characteristic, this being particularly noticeable in steam turbine operation.

INVERSION IN ALKALINE JUICES.

These data positively indicating inversion of sucrose in slightly alkaline juices, make it appear most probable that inversion in juices proceeds approximately in proportion to the hydrogen-ion concentration. At any rate, inversion in slightly alkaline juices is not at all inconsistent with our modern conceptions of acidity, neutrality and alkalinity. Neutrality means that hydrogen and hydroxyl-ions are present in equal concentrations, not the absence of dissociated ions. In passing from neutrality to alkalinity, that is, from *pH* 7 to higher values, hydroxyl-ions increase with a corresponding decrease in hydrogen-ions, the product of the two remaining constant. Thus hydrogen-ions are still present even in alkaline solutions, though in greatly reduced quantity. There is little reason to believe that the activity of the remaining hydrogen-ions is changed. From this point of view, some inversion would be expected in slightly alkaline juices, and indeed it would have been rather surprising had it not been detected.

While destruction of glucose was noted during the more alkaline clarifications, there was little, if any, evidence of any further destruction, when the same juices were further digested, at high temperatures.

The above considerations indicate the desirability of as alkaline a clarification as is practicable. While ill effects that might be anticipated from destruction of glucose do not impose a definite limit on the alkalinity, such a limit is imposed by the point at which the maximum increase in purity is secured, which, as a rule, is at about *pH* 8·6 in the juice after it has passed through the heater. The extent to which development of acidity then takes place is dependent on the temperature and how long the juice is exposed to high temperatures. Under ordinary operating conditions, with the juice leaving the heater at about the above reaction with the temperature approximating the boiling point, and the juice not over a couple of hours in the settling tanks, it should leave the latter at from 8·0 to 8·2 *pH*, and the syrup will probably be as alkaline as 7·7 to 7·8. If this is accomplished, any inversion in this part of the process will be absolutely negligible.

This technically desirable procedure cannot be approximated in many cases because of difficulties in filtration due to the large volume of settlings resulting from alkaline clarification, and we will not realize the full benefit of our present knowledge of clarification until the problem of filtering a large volume of settlings is solved. However, in such cases we should operate as alkaline as the capacity for filtering settlings will permit, and every effort should be made to obtain maximum efficiency from this equipment.

DETERMINATION OF THE *pH* VALUE

Mr. COOK has been working on the necessary modifications of a colorimetric method of determining the *pH* value. Preparing colour plates required has been a tedious operation, but with such a method developed to a satisfactory point, a definite language will be available for use when clarification or the reaction at which juices should be carried is under discussion.

In the absence of definite means for expressing the results of the investigations in terms that could be translated into factory practice, our original suggestion for approximately indicating the degree which investigation had shown to be desirable clarification practice, was before heating to lime the juice to a pink colour with phenolphthalein. The change in reaction varies in different juices. As the really significant factor is the reaction of the juice after heating, the use of phenolphthalein alone does not fully meet the requirements, and we would now add to our original suggestion the use of the two other indicators, thymol blue and cresol red, for use in the heated and clarified juice. The juice after passing through the heater should be sufficiently alkaline to give a distinct red with cresol red and a greenish colour with thymol blue. It should not be alkaline enough to give a blue colour with the latter indicator; at most the colour should be a greyish blue; within this zone the best results in clarification will be obtained. The cresol red will be particularly valuable where the volume of settlings prevents carrying quite this alkalinity; the colour change with this indicator passes through orange into yellow as the alkalinity is reduced. We would strongly recommend that when it is impossible to carry the alkalinity at the optimum point, the reaction be maintained alkaline enough so that cresol red gives a distinct orange colour in the heated juices.

Since the raw sugar investigation brought out the close relation of good clarification and good refining qualities in the sugar, even more attention than before has been given to applying the results of the clarification investigation during factory inspections, and Mr. SMITH has worked toward the same end in factory visits while working on refining qualities of sugar.

IMPORTANCE OF REGULAR LIMING

Next to insufficient liming, irregular liming has probably been the most serious fault in previous clarification practice. In many factories, different parts of a tank of juice still pass through the heater at widely varying reactions, which condition is objectionable on chemical considerations. Mr. MCCLEERY's observations this year have indicated that it is particularly objectionable from the standpoint of obtaining the clearest juices.

> "The use of the Kopke turbidimeter[2] has been a great aid in determining what good clarification from a physical standpoint really means. . . . If the raw juice and lime are mixed to an even reaction, and if this reaction is at the optimum point demonstrated by our previous work here (faintly alkaline to phenolphthalein, or about 8.8 *pH* on limed juice before heating), a Kopke turbidity figure of 1.0 can be expected for each 0.01 per cent P_2O_5 in the mixed juice. In other words with a mixed juice figure of 0.035 per cent P_2O_5, and conditions of liming and heating as above, the expected turbidity figure would be about 3.5. Fluming plantations have been found to exceed this figure somewhat; while it has also been observed that unless the mixed juice and lime-milk are thoroughly mixed before heating, the expected clearness of resulting clarified juice is not attained. An efficient means of mixing the juice and lime is essential, e.g., a compressed air coil, a propeller or set of paddles in the mixing tank under the juice scales. A excellent device for liming and mixing the juice is the one that has been developed at the Oahu Sugar

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[2] *I.S.J.*, 1924, 322.

Company. Clarified juice of 3·5 turbidity, usually corresponding to about 0·036 per cent. P_2O_5 in the mixed juice, is clear enough to see through when a tumblerful of ordinary water is held toward the light Mixed juice with more than this amount of phosphoric acid will give clearer juice than the above figure (though with an increased volume of settlings), while mixed juice that is deficient in this respect clarifies poorly, the turbidity decreasing with the increase in phosphoric acid. A number of factories having juices low in phosphoric acid, have in a limited way used superphosphate or double superphosphate to improve the clearness of the clarified juice. The response to this treatment has been immediate "

IMPROVED FILTER-PRESSING DESIRABLE.

Mr. SMITH has concluded as a result of his observations that if good efficiency is obtained from filter-press equipment and standard filter-press capacity is available, it should be possible to lime juices to the optimum point and handle the resulting volume of settlings, provided the phosphoric acid content does not exceed 0·03 to 0·04 per cent. Mr. SMITH has also concluded after observations at a number of factories that the conditions resulting in clear clarified juice are intimately related if not identical, with the conditions that result in a large volume of settlings.

On the whole, filtration is the most serious problem now before us in raw cane sugar practice in Hawaii. Our filter-presses do not meet technical requirements, nor do they economically separate the soluble from the insoluble in the settlings. Filtration problems, almost, if not quite, as difficult have been satisfactorily solved in other industries, yet no improvements have been made in raw cane sugar factories. Indeed some of our newer presses do not satisfy the requirements in some particulars as satisfactorily as presses the writer had experience with 25 years ago. To some extent our lack of progress may be attributed to isolation. To a great extent it is undoubtedly due to failure to fully realize the shortcomings of present equipment in advance of investigations in the last few years.

Trade Notices.

From Messrs. BLAIR, CAMPBELL & MCLEAN, LTD , of Govan, Glasgow, we are in receipt of a tastefully got-up 64-page Catalogue (No. 101) of Cane Crushing Plant as manufactured by them. This firm not long since acquired the old-established business of A. & P. W. McOnie, sugar machinery manufacturers of Glasgow, so apart from their own connexion of some 85 years with the equipment of the sugar industry, they also possess the experience long acquired by the McOnie Company in the same direction. The firm's works have recently been extended and are now equipped with the latest type of electrically operated machine tools, while their facilities for dealing with sugar mill equipment are claimed by them to be unsurpassed. The catalogue, which is printed in two or more colours, illustrates various types of crushing plant from 3-roller to 11-roller, and there are reproductions of blue prints showing in plan the more usual arrangements of mills with gearing. An interesting feature, that might well find wider employment in such catalogues, is the inclusion in nearly every view of a mill of the figure of a man, thus showing at a glance the comparative size of the plant.

Bailey's Safety and other Valves have a world-wide reputation for durability, and their latest catalogue as issued by the firm of SIR WILLIAM H. BAILEY & CO., LTD., of Salford, Manchester, will be found of use to all those concerned with boiler fittings for sugar factories.

The Sugar Industry in Portuguese East Africa.[1]

Pride of place among the plantation industries of Mozambique is enjoyed by sugar, and the chief centre of this culture is the lower Zambezi Valley, where the Sena Sugar Estates, Limited, cultivate a large acreage and own four large factories. Two of these—Caia and Marromeu—are on the south bank of the river in the Mozambique Company's territory, and two—Mopea and the new Luabo factory, which began operations last year—on the north bank in the district of Quelimane. The three older factories have a capacity of about 15,000 tons each per annum, but the Luabo mill can deal with 20,000, and has been designed with a view to eventual expansion to a capacity of 40,000 tons. In the 1924 season the four Sena factories produced just under 40,000 tons of sugar, but the exceptional floods early this year will reduce the current season's output. In the near future the output from the Zambezi mills should reach 60,000 tons per annum. The cane grown is the Uba variety.

The Sena Company, which began operations in the early 'nineties, as the result of the enterprise of Mr. J. P. HORNUNG in the face of great difficulties of transport—all the machinery having had to be carried up the river by canoe—is a striking illustration of what vision, indomitable persistence, and capable management can achieve. To-day, in addition to its large plantations and factories the company owns an elaborate transport system, consisting of Decauville track, well equipped with locomotives and rolling stock, on each of the four areas under cultivation, a 3 ft. gauge railway nearly 60 miles long connecting the factories at Marromeu and Caia with the Trans-Zambezi Railway, a large river fleet of steamers and barges, and the coasting steamer Waterbuck.

The Sena Sugar Estates, Limited, have an authorized share capital of £1,500,000, which has all been issued. The loan capital consists of £741,300 in 7 per cent. First Mortgage Debentures and £139,320 in 7½ per cent. Second Mortgage Debentures. In 1923 the net profit was £253,020, which enabled a dividend of 15 per cent. to be paid, £30,000 being placed to general reserve, £30,000 to depreciation reserve, and £30,048 carried forward. The company employs a staff of over 300, mostly Europeans, who are very well housed and provided with medical services, clubhouses, and facilities for recreation and sport. The native labour force numbers 16,000. On the four estates 18 sets of FOWLER steam ploughs are employed.

After the Sena Sugar Estates, Limited, the next most important sugar-producing organization is the Companhia Colonial do Buzi, which has two factories, with an aggregate capacity of 16,000 tons of sugar per annum, at Nova Luzitania, on the Buzi River, near Beira. The output was over 14,000 tons in 1924. Erection of a third mill is contemplated.

In the Lourenco Marques district the Incomati Estates have a factory at Xinavane, at the terminus of a branch railway connecting that point with the main line from the port to the Transvaal. Last September the new mill at Xinavane, which has a capacity of about 15,000 tons per annum, began crushing. The output of sugar in 1924 was 4751 tons and the current year's production is estimated at 9000 tons, rising to 12,000 tons in 1926 if climatic conditions are favourable. The share capital of the Incomati Estates is £350,000 and there are Debentures to the amount of £125,000.

Near Inharrime the Mutamba Estates, which have a share capital of £80,000 and a debenture issue of £30,000, possess a small factory which produced 700 tons of sugar last year (a poor season in that area). This year's output is estimated at 1500 tons and that of 1926 at 2500 tons, which is about as much as the existing factory can produce.

Several sugar-growing projects in the southern part of the province have been under consideration for some time past, but until the present uncertainty regarding the trend of sugar prices is relieved it is improbable that any definite decisions will be taken in regard to the initiation of new enterprises of this character.

Among companies recently registered are the following:—Commercial Alcohol Company, Ltd., 7, Princess Street, Westminster, S.W. 1 (Reg. No. 206,285); a private company; to acquire any invention relating to alcohol, etc. Nominal capital £30,000, in £1 shares.

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[1] Reproduced from the *Times Trade Supplement*, June 13th, 1925.

"Suma-paint."

Anti-corrosive for Iron and Steel Work.

"Suma-paint" is a graphite paint of the type which has been proved to be the most efficient and economical anti-corrosive covering available commercially for structural iron and steel work, corrugated iron roofing, and the like. It is well-recognized that ordinary lead paints have only a certain value as a protective covering for iron and steel structures, especially in the tropics.

Superiority of Graphite Paints.

Comparative tests which have been carried out from time to time in different countries have shown conclusively that, as compared for example, with red lead, paints made with graphite have a considerably longer life. This is only what one would expect, since, as every chemist knows, graphite (a form of carbon) is altogether inert to chemical effects and to climatic influences. It is regarded by engineers as the pigment *par excellence* for use with linseed oil for giving an impervious, heat and chemical resisting film, which well withstands the test of time.

Suitability for Sugar Factory Painting.

"Suma-paint" produces a covering which cannot blister, crack, peel off or discolour even under severe tropical conditions ; and, compared with ordinary red lead paint, it is undoubtedly a superior protective covering against the effect of tropical sun, rain, and corrosive action. In sulphitation factories the corrosive effect of the SO_2 on certain iron and steel work of the factory, notably the roofing, is often a matter for serious consideration. It has been found that ordinary lead paints do not withstand the combined effects of sulphurous acid gas, of heat, and of moisture for any reasonable length of time. Depreciation caused in this way, however, can be prevented by the use of "Suma-paint" applied at reasonably long intervals, and a large economy in the upkeep of the factory is thus effected.

"Suma-Paint" compared with Red Lead Paints.

"Suma-paint" has a very large covering capacity, as is shown by the following figures expressing the number of square feet which can be covered by 1 cwt. of different colours :— Natural grey, 10,000 ; steel grey, about 9000 ; light grey, about 7900 ; dark green, brown, or dark red, each about 6200 sq. ft , or, expressing these figures in terms of sq. ft. per gallon, they are :— 1450 ; 1500 , 1450 ; 1100 , 1200 , and 1150 for the five paints respectively. But the figure per cwt. for an average lead paint is less than 4000. Further, this paint is comparatively easily and quickly applied, its density and viscosity being less than that of ordinary materials.

The result of these three important factors, namely great durability, large covering power, and ready application, is a paint which works out much cheaper than ordinary paints (red lead, for example).

Directions regarding Application.

"Suma-paint" has been largely used in this country and abroad by railways, corporations, tramways, steamship companies, and by chemical works ; and has therefore been well tried and found thoroughly reliable and economical. It is now recommended as the ideal paint for tropical sugar factories, especially those employing sulphitation. An application of natural grey, which contains the maximum of graphite, should be made the primary coating ; and this, when dry, may be followed by one of steel grey, light grey, dark green, dark brown or dark red.

"Suma-paint" is sold only by: The Sugar Manufacturers' Supply Co., Ltd., of 2, St. Dunstan's Hill, London, E.C. 3.

Review of Current Technical Literature.[1]

CONTINUOUS CLARIFICATION OF CANE JUICE, USING HYDROGEN-ION CONTROL. *W. D. Stephenson. La. Planter, 1925, 74, No. 18, 353*

This article, headed " A new and most valuable clarification process for the sugar industry," describes work carried out at the Central Gomez-Mena, Cuba, on interesting and ambitious lines, namely, the elaboration of an automatic process for the clarification of cane juice, using *pH* indicators for so doing[2] Some extracts giving a general idea of the purpose in view are here produced: Raw juice is coagulated by heat in a machine known as a "coagulator," where simultaneously lime is applied by a most simple manner of control, and the reaction is observable in an observation glass tube where the operator checks his obversations with a specially prepared hydrogen-ion paper. So simple is this control and check system that an ordinarily experienced defecator mill-hand learns the process within a few minutes and become quite proficient within a day or two. An accurate control is maintained by the chemical laboratory using the colour test of the hydrogen-ion method. A skilled machine operator will maintain a control with a variation of 0·2 to 0·4 *pH*, merely by a visualization. On evacuation (continuous) from the coagulator the fluid is conveyed by pumps or gravity to a settler, where a system of parallel flow of fluids is utilized to precipitate the coagulated substances. This apparatus is continuously operated, and the *cachaza* are continuously drawn off at a central point, under observation of its operator, free from suspended matter, the clear juice being disposed of to the evaporator supply tanks. The coagulator is made in capacities of 2000 tons of juice per 24 hours and the settler in 2500 tons or less during a similar period of time, with an abundant reserve for overloads of a temporary nature. By the improved method under discussion the lime is added in a most dilute form and as sucrate and brought into contact with a most limited amount of juice, and never is there an excess of alkalinity as in the earlier method. The result is an instantaneous reaction Lime is introduced into the process only in sufficient quantities to accomplish neutralization of the acidity of the raw juice and to serve as a clarifying agent, thereby perfecting an economy in the use of lime over the present system of from 30 to 50 per cent. Of great value is the fact that there is no excess or uncombined lime, all lime introduced seems to be removed in this process (so it is said here), with consequent avoidance of fouling of the heating surfaces of the evaporating appliances with lime salts.

PROBLEM OF CORROSION IN SUGAR FACTORIES AND REFINERIES. *Russell B Williams. Facts about Sugar, 1925, 20, No. 20, 472-473.*

Handling pure and concentrated sugar liquors offers a serious problem to some plants. Wrought-iron pipe for their transfer can be used with complete satisfaction. On the other hand, impure liquors often contain elements that greatly accelerate corrosion and present a serious and expensive problem, necessitating the use of copper or other costly metal. Where sweet-waters are handled, the corrosion of iron is extremely rapid. Here copper must be employed Even, copper, however, will not resist the action of the waste waters from the bone-char filters, for here ammoniacal elements are always present. Generally speaking, there are two metals that have proven capable of decreasing the ravages of corrosion in sugar factories and refineries. They are copper and "Duriron." "Tantiron" and "Monel metal" are also rust-resistant in many of the applications of the sugar industry, but the cost of these make installations expensive. While it is utterly impossible to definitely name any metal that will fit all cases, the last-named three have withstood corrosive tests very well. But the following applications to various substances have been found generally accepted. For piping of raw juice, standard wrought-iron pipe; for raw juice pumps, cast-iron; for diffusion tanks, steel sides with steel perforated screens; for sulphur stations, cast-iron or copper for pipes and steel for the tanks, the vent pipes requiring a heavy coating of paint; for evaporators, cast-iron and steel.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I S.J.*

[2] It has been worked out by Gilchrist & Co., Chicago and Havana. Patents pending.

Concrete floors have proven successful, and in this connexion the writer is of the belief that concrete or tile ducts would go far toward solving the corrosion problem encountered in the vent pipes leading from the sulphur stations.

COLOURING MATTER AND ABSORPTION IN RELATION TO COLOUR AND DECOLORIZATION.

H. H. Peters and F. P. Phelps. Paper presented to the American Chemical Society, Sugar Section, Baltimore, Spring Meeting, 1925.

The record of the measurement of the absorptive indices, -log **t**, of a single saccharine dry substance before and after decolorization by 20 decolorizing carbons was presented before the Sugar Division of the American Chemical Society at New York in September, 1921, in a preliminary report entitled "Decolorizing Carbons." The measurements were made at wave lengths 435 μ, 450 μ, and thereafter at intervals of 40 millimicrons up to $\lambda = 660$ or 700 μ. At that time there existed no optical precision method by means of which the per cent. decolorization over the full spectrum as a whole might be calculated from a record of intensities of absorption (-log **t**) at a greater or lesser number of separate wave lengths In the meantime the authors have developed an optical precision method which has been applied in this final report. The degree of saturation of the colour of a solution is measured in colorimetric analysis in terms of *n* units of colouring matter, which evoke a colour sensation of *n* colour degrees. The same result may be obtained in spectrophotometric analysis by converting one particular specific absorptive index, -log **t**, into *n* units of colouring matter. This particular -log **t**, must be measured at $\lambda = 560$ μ, for which wave length, the absorption unit, -log **t**, which measures the presence of one unit of colouring matter in 1 grm. of saccharine dry substance, is known. It has been established by many integrations of all types of colouring matters, that a single absorption unit, -log t_1, at 560 μ, measures the sum total absorption over the full spectrum for any and all types of colouring matters, but for one unit of colouring matter only. The numerical value of -log t_1 at 560 μ has been found to be 0 00485. The number of units, *n*, of colouring matter per 1 grm. saccharine dry substance is thus determined by the ratio: $n =$ —log **t** at 560 μ 10 00485. It follows that the number of colouring matter adsorbed by the carbon is equal to $(n_O - n_D)$. The subscripts O and D are used to indicate that the symbol to which they are attached refers to the original dry substance and the decolorized dry substance, respectively. The per cent. decolorization is therefore equal to the ratio: $n_0 - n_0$ $100/n_0$. The same result may be obtained by substituting for n_0 and n_D the absorptive indices, -log t_0 and -log t_D at 560 μ. All carbons remove colouring matter selectively. The greater the activity, the greater is the selectivity of the carbon. Great activity in some spectral regions (generally between 560 μ to 700 μ) is always counterbalanced by sluggishness in other spectral regions, generally the blue. The changes in spectral distribution caused by selective adsorption of colouring matter by the carbons have been represented graphically.

PRELIMINARY NOTE ON SPECTRO-COLORIMETRIC ANALYSIS OF TECHNICAL SUGAR PRODUCTS.

H. H. Peters and F. P. Phelps. Paper presented to the American Chemical Society, Sugar Section, Baltimore Spring Meeting, 1925.

The study of typical absorption spectra and luminosity integrals of technical sugar products has led to the creation of a simple optical method by which a single analysis of intensity of absorption, -log **t** at λ 560 μ may be obtained, which is equivalent to a correct colorimetric determination. The various local types of colouring matters may be grouped and differentiated by means of their absorption ratios, Q, while the knowledge of the individual absorption units, (-log t_1 as the measure of 1 unit of colouring matter in 1 grm. of saccharine dry substance) may be utilized to great advantage in the creation of the new types of "Standard Yellows" of precisely known colour value expressed as *n* units of colouring matter. The antiquated arbitrary colorimetric "standard colours" with arbitrary colour values may thus be eliminated altogether. The elimination of these arbitrary standards is desirable on account of poor matches with the so-called unknown sugar colour.

The new types of serviceable standards are developed from the sugar products themselves. Colorimetric analysis is thus brought into agreement with the spectrophotometric analysis. The elimination of the former is neither advisable nor desirable.

DETERMINATION OF REDUCING SUGARS, USING SOLDAINI'S SOLUTION. *Rudolf Ofner. Zeitsch. Zuckerind. Czecho-Slovakia, 1925, 49, No. 27, 209–210.*

Soldaini's solution, a solution of cupric carbonate or bicarbonate, is probably the most suitable reagent for qualitatively determining whether a raw beet sugar contains invert sugar, but for this preparation there exist a great number of formulae. Of these the author considers unsuitable those in which the bicarbonate has been destroyed by heating, and proceeds in the following way : 190 grms of potassium bicarbonate and 135 grms. of potassium carbonate are dissolved in 700 c.c. of distilled water at 50–60°C., mixed with 130 c.c. of copper sulphate solution (the blue liquid of Fehling's solution, containing 9·0 grm. of cupric sulphate), diluted with distilled water, and after cooling made up to 1 litre. In the presence of traces of invert sugar, this reagent gives only a light reddish-brown precipitate, but, if amounts which should be determined quantitatively are there, a considerable reddish-brown or reddish precipitate of cuprous oxide is thrown down. On the other hand, in the complete absence of invert sugar, not the slightest brown or reddish separation can be observed ; a test carried out according to the prescribed procedure,[1] viz., heating at 106°C. in a salt bath, remaining quite clear during the first half-hour, or sometimes giving a slight white precipitate consisting of calcium chloride. Proceeding in this way, it is easy to decide which samples must be set aside for the quantitative invert sugar determination.

"CELOTEX" INSULATING BUILDING BOARD. *Advertising literature of Bivert & Firth, London, Agents for the United Kingdom for the American principals of "Celotex"*

At the Ideal Home Exhibition, held in London in March, samples of "Celotex" insulating building board were displayed by Bivert & Firth, the Agents for the United Kingdom of the Celotex Co , and following are extracts from their advertising literature : Directions are given for its use for framing, stucco finish, roof insulation, interior finish, sound deadening, and the like, in the construction and finishing of buildings. It is said entirely to replace wood planking, weather boarding, etc., to be much more economical to use, and to possess different advantages It combines high insulation value with structural strength, water-proofing and sound-deadening qualities all at the cost of one material. Tests made by the firm of Robt. W. Hunt & Co., Engineers, of London and New York, show that in the form of pieces 2 in. wide it has a tensile strength of 373 lbs. per sq. in. In regard to insulating properties, the National Physical Laboratory, Teddington, shows it to have a value for heat conductivity of 7·9, that is, about the same as for corkboard, while pulp board and white pine under the same conditions have values of 10·4 and 19·0. It impedes 80 per cent. of sound. "Celotex" is sold in boarding ½ in. and $\frac{7}{16}$ in. thick, 4 ft. wide and 8, 9, 10 and 12 ft. long, and costs (to the trade) 2¾d. per ft. super for the ½ in., and 3d. for the $\frac{7}{16}$ in., ex store London, packed in crates containing 18, 19, and 20 sheets, its weight being 5000 and 3000 ft. to the ton for the thicknesses mentioned. Immediate delivery of "any quantity" is guaranteed.[2]

CONSTITUTION OF PECTINS, AND THEIR DETERMINATION. *D. R Nanji, F. J Paton, and Arthur R. Ling. Journal of the Society of Chemical Industry, 1925, 44, No. 21, 253-258T.*

In regard to the determination of pectin, it is remarked that the calcium pectate method[3] is reliable so far as it measures the true pectinogen content, but it does not indicate the degregation products of pectinogen with which it is invariably associated. These substances also contribute towards jelly formation, and there is no reason why they should be excluded. Hence the authors have elaborated a method based on the definite yield of carbon dioxide from the glycuronic acid on heating with hydrochloric acid for four hours under conditions similar (details of which are here given) to those for determining pentoses, and this CO_2 content multiplied by 5·66 gives the percentage of pectin material existing both as pectinogen and pectic acid. This method has been extensively employed in an investigation dealing with the influence of pectin substances on the nature of straws, and some results are here summarized.

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[1] *Zeitsch. Zuckerind. Czecho-Slov.*, 1923-24, 48, 19 ; 1924-25, 49, 87.

[2] See also *I.S.J.*, 1924, 49, 496, 542, 652.

[3] *I.S.J.*, 1923, 248, *et seq.*

BEET DESICCATION PREVIOUS TO EXTRACTION. (*A*) *Charles C. Moore. Sugar Beet Journal, 1925, 7, No. 10, 14.* (*B*) *P. Hoc. Journal d'Agriculture pratique ;* through *Journal des Fabricants de Sucre de France,* May 2nd, 1925.

(*A*) Arguments in favour of the desiccation or dehydration of beets by the farmer, previous to transport to the factory, in order to save freight, are as follows :—A fair average for fresh beets is 16 per cent. sugar, which means that when the cossettes are dehydrated to a shrinkage of 3 to 1, they contain about 50 per cent sugar. If the average freight charge be taken as $1·50 per ton of fresh beets of 16 per cent sugar, or 4½ mills per lb. of sugar, it is lowered to 1½ mills (tenths of a cent) per lb. sugar, being a saving of 3 mills per lb of sugar. About 1000 B.T U. are required to evaporate 1 lb. of water , and a barrel of average fuel oil develops 6,200,000 B T.U. Therefore, if 3 tons of cossettes are dehydrated to 1 ton, it means that 4000 lbs. of water is evaporated, requiring 4,000,000 B T.U , that is to say, it requires about two-thirds of a barrel of fuel oil per ton of dried cossettes. If the cost of fuel oil be taken as $1·50 per barrel (a high figure), the cost is $1·00 per 2000 lbs of dried cossettes, being 1 mill per lb. of sugar. Total electric power, including that for the washer and slicer, is well under 100 h p , but 100 h p. is 1800 k.w h. per day (24 hours) for a dehydration plant of 200 tons, daily capacity, fresh beets , and the schedule charge for power (in California) is at the rate of one-fifth mill per lb. of sugar This makes a combined cost of fuel and power to be 1·2 mills per lb. of sugar, on a basis of fuel oil at $1·50 per barrel and electric power at ¾ cent per kilowatt hour. The labour cost, in a dehydration plant of 200 tons of beets per day capacity is : 1 man to attend the washer and slicer ; 1 man to feed the cossettes from the slicer into trays (20 trays per car) and to move the cars to the dehydrater man ; 2 men (one of them the foreman of the plant) to attend the movement of cars into and out of the dehydrater , and 2 men to move the cars of dried cossettes away from the dehydrater and discharge the dried cossettes into a hopper which feeds into a sacker (200 lbs. per sack), the sacks being conveyed to a freight car discharged in a storage room. This makes a total of 6 men, which, at an average wage of 50 cents per hour, totals $72 00 per day, being about one-mill per lb. of sugar. The speed of operations is one car (1200 lbs of cossettes) in the dehydrater, each 4 mins , and one sack (200 lbs.) of dried cossettes, each 2 mins. The overhead charges, consisting of interest on investment, taxes, upkeep of the plant, are safely within $4000 per year; and if the plant operates 60 days at capacity, an annual output of about 4000 tons of dried cossettes of 50 per cent. sugar content, it is about one-mill per lb. of sugar These several charges make a total cost for dehydrating cossettes, in a plant of 200 tons per day capacity, of 3·2 mills per lb. of sugar, against which there is a credit of 3 mills per lb of sugar as the saving in freight, assuming the freight charge is $1.50 per ton of fresh beets. In other words, the dehydration of cossettes is practically paid for in the saving of freight costs on beets to the sugar factory. Sugar factories using dried cossettes can run throughout the year instead of the 100-day season as now, reducing their overhead to one-third of what it now is, per lb. of sugar, and reducing their labour cost very materially.

(*B*) This article relates particularly to the question of desiccating beets for making *farine de betterave* (beet meal) for use principally as fodder, and the author states that the problem has been solved economically by M. LAFEUILLE, who has installed at Chignat-Vertaison (Puy-de-Dôme), France, a *sécherie* for converting the roots into a very concentrated fodder, unfermentable, which can be transported (in France) at four-fifths of the cost of ordinary cossettes. It has a composition consisting approximately of : water, 12·8 ;

sugar, 59·4; nitrogenous matter, 6·9; fatty matters, 1·6; other hydrocarbons, 8·6; cellulose, 4·9; and ash, 5·8 per cent. Trials made with this beet meal in cattle feeding under the most varied conditions have given highly satisfactory results. One ton of roots is said to give 250 kg. of the meal and to require 120 kg. of "fuel" (thermal value not mentioned).

Alcohol Motor Fuel from Molasses. I: Use of Cane Molasses for Manufacture of Motor Fuel. *E. C. Freeland. Industrial and Engineering Chemistry, 1925, 17, No. 6, 615-621.*

This is a general review of the question, dealing in particular with the following: alcohol as the motor fuel of the future; its production from molasses, yield and costs; denaturation of motor spirit, ether manufacture, its yield and cost, and chemical control of alcohol production. Most of the important data given here has already appeared in these columns, but it is of interest here to reproduce the following statement of the problems awaiting research in what really is an infant industry[1]: *Use of different raw materials for alcohol manufacture.*—Ormandy[2] estimates that 5 per cent of the American grain crop would yield sufficient motor fuel to replace the gallons demanded in America. A study of the possibilities of tropical crops as raw material should be undertaken. *More efficient methods of fermentation and distillation*—Increased yields of alcohol from molasses, and also of ether from alcohol, will lower the cost of production and thus allow the fuel to be sold at a lower price. *Methods of producing absolute alcohol.*—The production of absolute alcohol for motor fuel purposes will eliminate many difficulties now encountered, as absolute alcohol will mix more readily with other substances than 95 per cent. alcohol. *Means of stabilizing ether.*—The amount of ether present in motor fuel mixtures gradually decreases through evaporation, owing to its high volatility. Moreover, autoxidation of ether takes place[3] forming ethyl peroxide, acetic aldehydes, and acetic acid. Means for reducing this loss should be studied. *Composition of fuel.*—The type of fuel produced at present does not give maximum efficiency and better motor fuel mixtures should be developed. *Denaturants.*—The present cost of denaturing alcohol is very high and very often the denaturant is not suitable. There is great need of a cheap and efficient denaturant. *Cause of corrosion in engine cylinder and method of prevention.*—A large amount of work has already been done on this problem, but further work is necessary in order to eliminate all corrosion and pitting of engine parts. *Adaption of fuel to existing engines and development of new types of engine.* A means of securing better results, using alcohol fuel in existing engines, and the development of special alcohol engines will increase the amount of work secured from this fuel and therefore extend its use. *Regulations regarding manufacture of industrial alcohol.*—In almost every country where alcohol is manufactured, beverage and industrial alcohol are put on almost the same basis with regard to government regulation. A change in this system is essential to the establishment of the industrial alcohol industry. *Patent regulations.*—A number of mixtures patented in Great Britain and other countries, containing alcohol, ether, fatty acids, combustible gases, etc., with or without hydrocarbons, contain nothing essentially new, and patents should not have been granted.[4] Great damage may be done to the prospect of early production of new motor fuels, if disregard is shown by Patent Offices for the known miscibility within various limits of alcohol, benzol, petrol, and other hydrocarbons. Any claim to a master patent should in any conceivable circumstances be viewed with the maximum of doubt.[5] *Marketing.*—Means should be studied of establishing and maintaining a market for motor fuel at a price in proportion to its fuel value. Alcohol motor fuel will never compete with gasoline unless the consumer is able to secure with it a greater mileage for a given sum.

J. P. O.

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[1] Some of these problems are of course receiving attention by the Empire Motor Fuel Committee and other bodies, and by individuals —Ed., *I.S.J.*

[2] *J. Intern. Petroleum Tech.*, 1918, 5, 33.

[3] Clover, *J. Am. Chem. Soc.*, 1922, 44, 1107. [4] *I.S.J.*, 1919, 22, 402

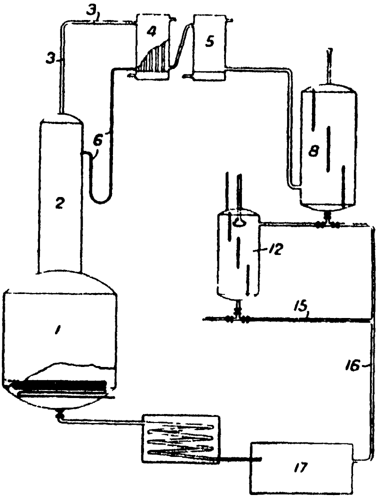
[5] Report of Empire Motor Fuel Committee, 1920

Review of Recent Patents.[1]

UNITED KINDGOM.

Production of Alcohol Motor Fuel. *Distillers Co., Ltd*, of Edinburgh, and *H. B. Hutchinson*, of Harpenden, Herts. *232,276.* October 17th, 1923.

Motor spirit consisting of a stable mixture of alcohol and petrol or other hydrocarbon oil is obtained by distilling the mixture until the greater portion of the contained water has passed over, allowing the distillate to stand, and mixing the layer consisting mainly of alcohol and hydrocarbon with the mixture of alcohol and hydrocarbon remaining in the still. In an example a mixture of equal volumes of low grade petrol and alcohol of 95 per cent. strength is heated in a still *1*, and the vapour passed through a fractionating column *2* into a separator *4* maintained at 58-65°C. Any condensate is returned to the column *2* by a pipe *6*. Uncondensed vapours are led to a condenser *5* from which the liquid is run into a separating vessel *8*. The lower layer of water with some alcohol is run into a vessel *12* and sprayed with water or brine to separate any contained hydrocarbon, the aqueous alcohol is run off to a separate still and concentrated, and the hydrocarbon is run through pipes *15*, *16* to a container *17* in which it is mixed with the alcohol-hydrocarbon layer from the vessel *8*, and with the cooled residue from the still *1*. At the commencement of the distillation the temperatures in the separator *4* and in the exit pipe *3* may be kept at 45 and 55-58°C. respectively, to admit of the lower boiling constituents of the petrol being partially separated and run direct to the container *17*.



Production and Application of Active (Decolorizing) Carbons. (*A*) *E. Goutal and H. Henne-Butte*, of Paris. *231,863.* March 31st, 1925, convention date. April 1st, 1924. (*B*) *Artificial Coal Co. (Hamon Process) Ltd., and Count L. de W. Hamon*, of London. *231,936.* January 9th, 1924.

(*A*) A compressed fuel or carbon for absorption and catalysis consists of a ligneous substance such as wood, peat or lignite carbonized below 500° C., a binder comprising oxidized substances obtained from the heat treatment of tar from wood, peat or lignite, which are decomposable below 500° C. into water and a non-distillable carbon residue, and, optionally, a small quantity of inorganic oxides or salts, e.g., of copper, nickel, zinc or iron. The mixture is pulverized and compressed either hot or cold and then heated to between 300° C. and 500° C until water vapour ceases to be evolved. In an example, 2 parts of the half coke resulting from the carbonization of clean peat at a low temperature are ground with 3 parts of peat tar which has been oxidized by the air at a moderate temperature. After compression under heat the mixture is progressively heated to 500° C.

(*B*) Carbon for decolorizing sugar, oils, wax, etc., for deodorizing and other purposes is prepared from peat, lignite, sawdust, and similar carbonaceous materials by the following process: First the water content of the material is reduced to 25 to 30 per cent.; and, after grinding and adding an alkaline earth compound such as calcium hydrate to facilitate its disintegration, the material is passed into a retort by means of a worm feed or otherwise, ingress of air being prevented during charging. The retort is heated sufficiently to carbonize the peat, and gases such as carbon dioxide, superheated steam, hydrogen or chlorine are introduced. Either a rotating retort or a stationary retort provided with stirrers is employed. The carbonized material is delivered into a trough of water and is passed in tanks containing acid which is kept heated and agitated, for example, by means of a perforated steam-coil. The ash having been dissolved the carbon is washed with water, dried, and ground.

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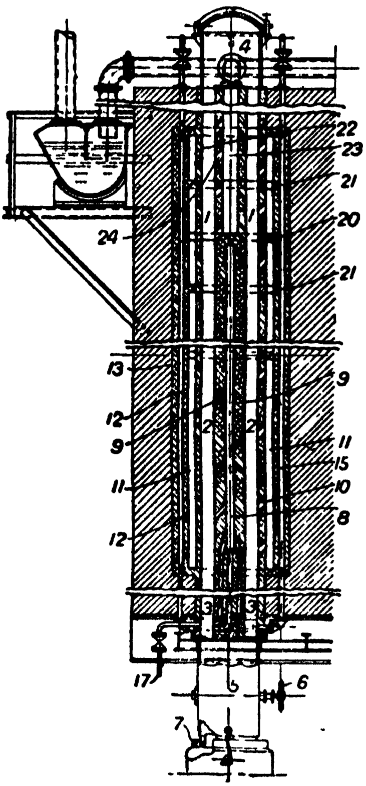
[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C 2 (price, 1s each) *United States* · Commissioner of Patents, Washington, D.C. (price 10 cents each) *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

PREPARATION OF (ACTIVE) DECOLORIZING CARBON.[1] ***J. N. A. Sauer***, of 2, Den Texstraat, Amsterdam, Holland. *230,293*. April 5th, 1924.

Decolorizing carbon is made from carbonaceous material in a vertical retort by the action of heat and of activating gas or vapour passing through the carbonaceous material transversely of the retort chamber. The cylindrical retort has an annular chamber comprising zones *1*, *2*, *3* which receive a charge from a hopper *4*, zone *1* being a distilling zone, zone *2* an activating zone, and zone *3* a cooling zone. The material travels through these zones into a valve box *5* having a valve or sluice controlled by a handwheel *6* to drop the finished carbon at intervals into a receptacle. Alternatively a continuously discharging automatic rotating valve may be provided. A water seal *7* between the box *5* and the receptacle prevents access of air. The central duct *8* is supplied through three inlets with combustible gas from a pipe *17*, air preheated in a channel *13*, and steam superheated in a channel *15*. These gases pass through channels *9* in the annular retort chamber and transversely through the charge. The reaction gases pass through the ports *10* into the chamber *11* in which they are burned with air entering through the ports *12*. The products of combustion from the annular chamber *11* flow upwards into an extension of that chamber in which there are baffles *20* having apertures *21* whereby the gases are caused to flow round the outer wall of the distilling zone *1*. Then the gases pass inwards through ports *22* to the zone *1*, where they pass tranversely through the fresh material and enter a central duct *23* through ports *24*. The duct *23* communicates at the top with a discharge pipe which passes through the hopper *4*. Examples of carbonaceous materials that may be used are wood, peat, anthracite, cannel coal, brown coal, leather, charcoal, and coke. Examples of activating gases and vapours that may be used are steam, air, carbon dioxide, carbon monoxide, hydrogen, generator gases, ammonia, chlorine, and vaporized chlorides.



CENTRIFUGAL SEPARATOR [FOR CLARIFYING CARBONATED JUICES]. ***Fredr. W. McEntire***, of Salt Lake City, Utah, U.S A. *225,396*. December 18th, 1923.

A centrifugal machine for the clarification of carbonated juice is described, having a basket and a basket frame which are rotatably at slightly different speeds, the difference in speed being utilized for conveying the material upwards between basket and frame. Material is fed from the source of supply through a hollow sleeve into the bottom of the basket; basket and basket frame are rotated at slightly different speeds, and the material is thus forced outwardly by centrifugal action. Being slightly heavier than the liquid, the solids are thrown furthest; they engage the wall of the basket; and are carried upward by the spiral guideways until they reach the level of an upper chamber, when ploughs gradually and gently change their spiral direction into a radial one and they are fed into a stationary collecting pipe. In the meantime, the liquid remains in the central portion of the basket, and is carried upward through the opening into the lower chamber from whence it is discharged.

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[1] See also *I.S.J.*, 1925,

CENTRIFUGAL LINING. *J. Y. Johnson (Van Lelyveld & Co.*, of The Hague, Holland). *230,393.* November 15th, 1924.

Strainer separators having a perforated outer wall and a perforated inner plate are provided with an intermediate member, which consists of a corrugated, perforated plate. Corrugations extend in a vertical direction, and one side of each corrugation has a steeper slope than the other. The perforations are all in the same sloping side of the corrugations and may extend over the bends of the plate.

POLARIZER OR ANALYSER FOR POLARISCOPES (OR SACCHARIMETERS). *Optische Anstalt C. P. Goerz A.-G.*, of Berlin. *231,848*, March 18th, 1925; convention date, April 7th, 1924.

As polarizer or analyser of a polariscope, polarimeter, or saccharimeter, a doubly-refracting crystal is employed. Referring to the illustration of the invention, Fig. 1 shows a simple lens *1* the axis of which is at right-angles to the axis of the crystal, a shutter *2* is employed to cut out one of the refracted beams. The lens *1* may be used in conjunction with a glass lens *5*, Fig. 3, which as shown renders one of the beams divergent, thus avoiding the use of a shutter. An object *8* illuminated by the other beam can be projected by an image producing system *6*. The lens *5*, or a system of lenses, may be so selected as to form, in combination with the lens *1*, a non-focal system which can be placed in front of an image-producing system.

FIG I

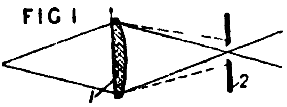
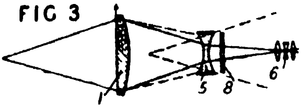


FIG 3



SEPARATION OF COLLOIDS FROM SUGAR JUICES AND THE LIKE. *K. Yamashita*, of Kitatoshima-gori, Tokyo, Japan. *231,430.* December 30th, 1924; convention date, March 29th, 1924.

Colloids dissolved or suspended in liquids are separated by adding a floating medium or media such as oils, creosote, or coal tar, and also adding to or producing in the liquid a gas and agitating the mixture uniformly so as to produce minute gas bubbles which attract and collect the colloidal matter and are themselves collected, with the aid of the floating medium, in the upper layer of the liquid by allowing it to settle or by other means such as by centrifuging. In one example, colloidal matter, such as pectins and gummy substances, is separated from roughly filtered cane sugar juice by adding petroleum and calcium carbonate and then treating with sulphuric acid and agitating. The bubbles of carbon dioxide produced are then collected. This treatment permits the omission of some steps in the treatment of the juice, for example the first filtering in a filter-press, and is said to increase the yield of sugar and decrease the amount of molasses produced. Molasses may be treated in the same manner as the cane sugar juice to produce a practically pure crystalloid solution, water being first added if necessary. The gas may also be added to the liquid under treatment by dissolving carbon dioxide therein under pressure and then reducing the pressure so that gas is emitted, or by blowing in air. The floating medium or media may be added before or after the gas, or at an intermediate stage. The process may be applied to the removal of colloidal impurities from vegetable juices, to the recovery of fatty acids from the waste liquid of silk-scouring, or to the removal of cloudiness from beer; or, generally, to the removal of colloidal substances from any liquid.

UNITED STATES.

SAVE-ALL (OR ENTRAINMENT ARRESTOR) FOR EVAPORATORS AND VACUUM PANS. *Ernst W. Kopke*, of Manila, P.I. *1,525,136.* February 3rd, 1925.

Referring to the drawings illustrating the invention, *1* indicates the main shell of a typical evaporator, such for example as a vacuum pan, which is provided with a conical head section *2* terminating in the discharge neck or outlet *3*. Mounted within the cylindrical shell of the evaporator, and preferably near the upper end of said shell and below the outlet *3*, is a transverse or diaphragm *4*, which is fashioned to fit accurately within the shell, which is usually circular in cross section, said diaphragm being secured in position by brackets or angle sections *5*. The diaphragm is provided with a relatively large central opening *6* through which the vapours and any liquid entrained therein pass. The outer peripheral portion of the diaphragm *4* is provided with a series of drainage orifices *9* which are located adjacent the wall of the evaporator shell *1*, and secured to the upper face of the diaphragm is a series of baffle plates *10*, each of which overhangs a drainage orifice *9*, the body portion of each baffle plate being inclined at an angle of substantially 60° to the plane of the diaphragm. Mounted above the central opening *6* of the diaphragm *4*, is a deflector plate *7*, which is preferably in the form of a flat disc approximately twice the diameter of the opening *6* and disposed concentrically with the latter, and interposed between the diaphragm *4* and the deflector plate *7*, is a series of arcuate vanes *8* which extend from the edge of the diaphragm surrounding the opening *6* to the circular edge of the deflector plate *7*, said plates being disposed in circular series about the opening *6*, as indicated in Fig. 2. Operation of the device is as follows: The vapours generated in the boiler section of the evaporator pass at relatively high velocity through the central opening *6* toward the discharge opening *3*, and tend to carry with them varying percentages of liquid, depending upon the character of the primary liquid which is being operated upon. The vapours and entrained liquid passing through the opening *6* in the diaphragm *4* impinge upon the deflector plate *7* above the opening *6*, which changes the course of the flow of vapour liquid abruptly from a vertical direction toward the outlet *3*, to a horizontal direction across the diaphragm *4* and toward the wall of the shell *1*. In addition to the change of direction of flow from a vertical to a horizontal, the vanes *8* impart to the vapours and entrained liquid, a whirling movement so that they sweep over the top surface of the diaphragm at relatively high velocity and impinge on the under inclined faces of the baffle plates *10*, which are effective to arrest the liquid carried by the vapour and cause the latter to be discharged downwardly through the orifices *9* into the portion of the evaporator chamber *1* below the diaphragm. The disposition of the baffle plates in peripheral series around the diaphragm *4*, and inclined at an angle to directly oppose the centrifugal whirl of the vapours produced by the

Fig. 1

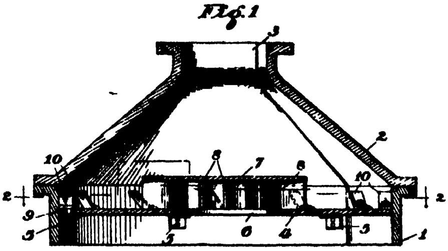


Fig. 2

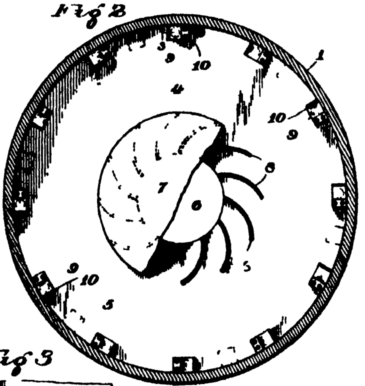
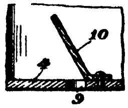


Fig. 3



deflector plate *7* and the arcuate vanes *8*, is effective in setting up a relatively strong down-draft through each of the orifices *9*, thereby not only insuring a prompt discharge of the separated liquid from the vapours, but also preventing any upward flow of the vapours through said orifices *9*. In practical application to vacuum pans or similar devices for sugar juices, the apparatus has been found to be effective in separating and recovering the entire liquid content of the vapours, and returning the recovered liquid to the boiler section of the evaporator. Obviously the diaphragm and associated deflector plates *7* and arcuate vanes *8* may be constructed and assembled in various ways, or if desired may be formed as an integral casting. When, however, it is desired to apply the device to an evaporator that has already been installed and in use, the diaphragm may be formed of one or more sheets or sections, or the diaphragm and the associated deflector plates and vanes may be formed of multiple castings which may be individually introduced into the evaporator shell through the usual manhole, and assembled within the evaporator in the general arrangement indicated in the drawings.

OPEN EVAPORATOR FOR JUICE, USING DIRECT FIRE. *Mario Terán L* and *Manuel Maria Terán L.*, of Valera, Venezuela. *1,514,482*. November 4th, 1924 (Five figures; five claims.)

Claim is made for · "A sugar evaporating plant designed to effect the expeditious and convenient handling of sugar juices, which includes a plurality of heating receptacles, a single means for receiving juice from the press and adaptable to deliver it into one or the other of said receptacles, a defecator disposed at a level lower than the heaters, a plurality of evaporators disposed in a group at a level lower than the defecator, connexions between the heaters, the defecator and the evaporators whereby the juice will naturally flow from the heaters to the defecator and from the defecator to the evaporators by gravity, and means in said connexions to control said flow whereby the juice can flow from either one of the heaters to the defecator and from the defecator into any one or more of the evaporators."

SETTLING TANK FOR THE CLARIFICATION OF LIQUIDS. *Harald Ahlquest*, of New York, U S A *1,526,197*. February 10th, 1925.

A settling tank (for use more particularly for liquors obtained in the paper industry to facilitate the settling of solids from them) comprises a somewhat conical vessel provided with a device along its rim by means of which a uniform distribution of the unclarified liquor may be brought about As the liquor traverses these side walls the mud settles out and flows along them but near the point of convergence the liquor changes the direction of flow and passes along the axis of the vessel in a stream which is separated from the entering liquor. The latter accordingly forms a somewhat annular stream and the liquor which is flowing in the reverse direction toward the outlet is in a somewhat cylindrical stream Claim 17 reads · Apparatus for the clarification of liquids containing solids in suspension comprising a vessel of inverted bell shape, a launder extending around the open end of the vessel, a driven shaft supported in the vessel and provided with stirring means entering the launder, a bell-shaped tank supported in the vessel about the shaft with its open end down, an outlet conduit communicating with the upper end of the tank, an outlet from the lower end of the vessel, and agitating means mounted on the shaft adjacent the outlet.

CENTRIFUGAL MACHINES. (*A*) *Philip T. Sharples*, of Merion, Pa., U.S.A. Re *15,954* (originally 1,401,196 of December 21st, 1921). November 26th, 1924. (*B*) *William V. Boek*, of Eagle Point Colony, Ohio, U S.A. *1,521,858*. January 6th, 1923. (*C*) *Selden H. Hall* (assignor to *The De Laval Separator Co.*, of New York). *1,525,808*. February 10th, 1925. (*D*) *Carl G. T. Salenius*, of Bohns, Sweden. *1,530,417*. March 17th, 1925

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending June 30th		Six Months ending June 30th.	
Unrefined Sugars.	1924. Tons	1925. Tons.	1924. Tons.	1925. Tons
Poland	....	....	20,761	9,020
Germany	....	65	....	1,963
Netherlands	....	....	....	....
France	....	. ..	....	....
Czecho-Slovakia	2,317	204	19,762	1,032
Java	5,203	1	21,830	1,863
Philippine Islands	....	....	....	....
Cuba	13,358	68,039	267,705	396,202
Dutch Guiana	....	....	....	....
Hayti and San Domingo	17,825	19,709	84,364	99,829
Mexico	....	....	....	....
Peru	3,392	296	50,479	36,627
Brazil	....	....	22,328	6,540
Mauritius	2,930	1,800	90,659	12,690
British India	....	....	....	....
Straits Settlements	...	...	....	....
British West Indies, British Guiana & British Honduras	6,919	19,000	47,084	83,897
Other Countries	8,820	1,455	53,960	42,107
Total Raw Sugars	**60,764**	**110,569**	**678,934**	**691,772**
Refined Sugars.				
Poland	351	. ..	15,095	13,280
Germany	3,234	287	3,360	5,984
Netherlands	5,814	11,330	86,312	92,052
Belgium	120	1,590	19,630	10,448
France	....	....		....
Czecho-Slovakia	30,150	13,794	132,197	119,851
Java	....	....	....	....
United States of America	10,913	23,634	36,728	46,259
Canada	4,122	15,707	16,270	53,225
Other Countries	967	....	4,309	1,533
Total Refined Sugars	**55,670**	**66,343**	**813,901**	**342,632**
Molasses	30,522	30,076	103,622	112,749
Total Imports	**146,956**	**206,988**	**1,096,457**	**1,147,153**

EXPORTS.

	Tons	Tons.	Tons	Tons
British Refined Sugars.				
Denmark	20	101	198	570
Netherlands	37	9	177	85
Irish Free State	3,909	4,107	23,882	24,639
Channel Islands	72	62	514	414
Canada	....	..	....	..
Other Countries	656	1,810	3,347	5,375
	4,694	6,088	28,119	31,083
Foreign & Colonial Sugars.				
Refined and Candy	95	138	671	747
Unrefined	21	69	4,985	326
Various Mixed in Bond	....	....	....	....
Molasses	23	19	1,230	214
Total Exports	**4,833**	**6,314**	**35,005**	**32,370**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1925. Tons.	1924. Tons.
Total Receipts, January 1st to July 1st	2,012,878	1,849,702
Deliveries ,, ,,	1,878,555	1,785,510
Meltings by Refiners ,, ,,	1,750,330	1,669,910
Exports of Refined ,, ,,	130,000	91,000
Importers' Stocks, July 1st	134,323	64,986
Total Stocks, July 1st	277,305	192,025
	1924.	1923.
Total Consumption for twelve months	4,854,479	4,780,684

Cuba.

Statement of Exports and Stocks of Sugar, 1922-1923, 1923-1924, and 1924-1925.

(Tons of 2,240 lbs.)	1922-23 Tons.	1923-24 Tons	1924-25 Tons
Exports	2,357,833	2,231,001	2,602,086
Stocks	669,543	929,239	1,290,663
	3,027,376	3,160,240	3,892,749
Local Consumption	52,500	50,000	72,000
Receipts at Port to May 31st	3,079,876	3,210,240	3,964,749

Havana, May 31st, 1925

J. Guma.—L. Mejer.

United Kingdom.

Statement of Imports, Exports, and Consumption of Sugar for Six Months ending June 30th, 1923, 1924, and 1925.

Imports.	1923. Tons	1924. Tons.	1925 Tons
Refined	242,902	313,901	342,632
Raw	646,657	678,934	691,772
Molasses	77,994	103,622	112,749
	967,553	1,096,457	1,147,153

Exports (Foreign).	1923. Tons	1924. Tons	1925 Tons.
Refined	2,682	671	747
Raw	10,270	4,985	326
Molasses	1,932	1,230	214
	14,884	6,886	1,287

Home Consumption	1923 Tons.	1924. Tons.	1925. Tons
Refined	198,227	263.911	352,239
Refined (in Bond) in the United Kingdom	463,223	460,030	408,024
Raw	71,159	49,863	44,524
Total of Sugar	732,609	773,804	804,787
Molasses	5,311	3,711	3,673
Molasses, manufactured (in Bond) in United Kingdom	28,873	29,614	29,485
	766,793	807,129	837,945

Stocks in Bond in the Customs Warehouses or Entered to be Warehoused at June 30th, 1925.

	1922 Tons	1923. Tons	1924. Tons.
Refined in Bond	59,450	46,550	39,700
Foreign Refined	73,100	69,850	23,200
,, Unrefined	259,100	189,200	283,750
	391,650	305,600	346,650

United Kingdom Monthly Sugar Report.

Our last report was dated the 9th June, 1925.

The general tendency of the market during the period under review has been easier. At the start there was a slight hardening of prices, but at the close the market was weak and quotations for all descriptions were lower than at any point of the campaign. This state of affairs has been brought about by rain on the Continent, which dispelled all fears of drought in Europe, and continued pressure of the enormous Cuban production, the balance of which has still to be marketed.

Business on the terminal market has been in large volume. The speculative bull interest has been disappointed, and whilst some are realizing, the bulk of the bull account both here and in New York is being transferred to forward months. June was finally liquidated at 16s 1½d. There was very little doing in July, and only about a thousand tons was tendered in liquidation of this delivery. Isolated transactions took place in July from 16s. 6d. to 16s An enormons business has been transacted in August delivery owing to the liquidation of "longs" and transfers to forward positions. August sold from 16s. 6¾d. to 16s 9¾d. to 16s. 2¼d. to 16s. 3¾d. to 15s. 7½d. New Crop was at the outset firm and large speculative buying orders ensued consequent upon the prevailing dry weather in Europe October sold at one moment up to 17s 0¾d. and December to 17s. 2¼d. but since then has fallen to 15s. 8¼d. and 15s. 10½d. respectively. March sold from 17s. 4½d. to 16s. 1½d.; May sold from 17s. 4½d. to 16s. 3¾d. The latest prices are July 15s. 6d., August 15s. 8¼d., October 15s. 9d , December 15s. 11¼d., March 16s. 2¼d., and May 16s. 6d.

Trading in actual sugars has not been so active as formerly, and the distributing houses and manufacturers are all holding dear sugar and all their confidence has forsaken them. They continue their policy of buying strictly from hand to mouth, and at any rate in the U.K. the invisible supplies cannot be large. Fine granulated on the spot sold from 29s. 10½d. duty paid, less 1½ per cent., to 29s. 3d. A large business was done in American and Canadian granulated, which sold from 17s. 3d to 16s. 3d. c.i f. London, whilst to other parts 1½d. to 3d per cwt more was obtainable A scarcity still exists in Czecho sugars, and it has been difficult to buy either for ready or for forward delivery for this campaign. Dutch granulated has been more plentiful, and sold from 17s. to 16s. 3d. f.o.b. from ready to December. Belgium at one moment appeared to be more anxious to sell, but latterly has gone into her shell again. The value of Belgium Fine is 15s 7½d and crystals 16s 1½d. White Javas for May/June, June/July shipments have been sold down to 15s. 4½d. c.i.f., but this class of sugar is not pressing

The British and Continental Refiners have continued their purchases of Raws, and a fair business has been done in Cuba and San Domingo Raws from 12s. 7½d. down to 12s. c.i f. This latter price is the lowest so far registered this year, and in fact, with the exception of the period of panic prices in 1921/22 owing to the financial crisis in Cuba, the lowest prices since pre-war days.

The U.K. Refiners have done a steady trade and have been kept busy delivering old contracts, but compared to other market quotations there is little change in their price. Two alterations took place in their price; on June 24th, granulated was reduced by 6d. per cwt. but other makes remained unchanged. Again on July 10th all quotations were reduced by 6d. per cwt. The latest prices are No. 1 Cubes, 34s. 9d , London Granulated 30s. 1½d.

The demand in America was good at the outset, but latterly the distribution to the trade has been disappointing. It is estimated that the U.S. consumption is 300,000 tons in excess of 1924. The Refiners have been constant buyers, but the price for raws has gradually fallen from 2⅝ to 2¼ cents per pound, and the latest transaction reported is 2⅜ c.i f. New York.

The Cuban crop progresses satisfactorily. The receipts at the ports to date are nearly 900,000 tons more than last year, but the exports up to the present are 550,000 tons higher than the corresponding period of 1924. There still remain 13 Centrals working against 4, and there is every indication that the crop will probably be 5,100,000 tons.

With regard to the European crops, the latest report from Mr. F. O. LICHT gives the sowings as slightly in excess of last year. The dry weather which prevailed in the early part of the crop has not continued, and beneficial rains have occurred which have improved conditions considerably. However, it is not anticipated that the total European crops will be as large as last year in view of the abnormally high yield of 1924/25.

21, Mincing Lane,
London, E.C. 3.
July 13th, 1925.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 320. AUGUST, 1925. VOL. XXVII.

Notes and Comments.

Industrial Affairs at Home.

The last few weeks have been anxious ones for industry generally at home, because the coal trade has been on the verge of a disastrous strike which promised to extend (by way of sympathy) to the country's transport, and possibly to other key industries. The mine owners declare they are losing money at the present rate of wages and coal prices, and that the miners must agree to work longer hours or take less money in wages. The miners on their part refuse to work a minute longer than their seven-hour day or to accept a penny less in wages, and allege on their part that the mines are not economically worked or managed. Each party from its standpoint refused to depart an iota, and a hurriedly arranged commission of enquiry failed to move the opposing elements in time for the end of July when, failing an agreement, the strike was timed to begin. It did, however, ascertain enough facts to warrant the Government in concluding that there was room for a more prolonged and complete investigation by an independent body. The thing then was to decide whether to let the strike develop with probably disastrous results to the whole industrial community for lack of coal, or to stave it off at a price, till a Royal Commission had done its best to ascertain the facts regarding the present-day economics of the coal trade, and public opinion would be better informed as to the merits and demerits of the respective contentions. The Government had to take into consideration the fact that the transport men were determined on their part to assist the miners by refusing to move any coal already mined; and it was not hard to see that the effect of this would be to throw the country into industrial chaos for a period that could not be forecasted, and would in any event be very costly both to industry and to the taxpayer. So the Government took the only practicable step in the circumstances and agreed to subsidize the mines for a few months, so that the owners could afford to go on paying existing wages; in the meantime the whole subject of the economics of mining is to be investigated by a legally constituted body which, it is hoped, will be as largely non-partisan as possible—the partisans are wanted in the witness chair, not on the judicial bench. This decision has been criticized in the popular press as a concession to trade union pressure and as merely deferring the day of battle. But there are good grounds for hoping that if the problem of cheap coal production can be settled by next spring, a large step will have been taken in removing one of the causes of industrial unrest in this country; while if no solution is possible by consent of both owners and workers, the country will be more completely in possession of the facts, and the Government will be on better ground for dealing with any industrial strife that, at the worst, might come to a head.

We mention this subject of coal because it is so important a key industry in this country that any cessation of its production means a stoppage in the industries using it as raw material. The sugar machinery making firms who have been fortunate to secure orders not only for beet factories at home but for cane sugar plant abroad would soon be shut down, and failure to complete their contracts to time would repercuss in the sugar industry itself where prompt delivery in time for a given crushing season is of such patent importance. And failure of that sort does not end with the orders in process of execution, since the fear of prolonged or renewed stoppage affects decisions to give other orders. For these reasons one welcomes the Government's success in tiding over the crisis, and one refuses to accept as indisputable the dictum of some observers that the crisis is bound to come later on and might as well have come now. The fact is the whole world's coal trade is unsettled at the moment, and it is conceivable that further time for reflection and deliberation may induce a more reasonable attitude on the part of the contending parties, and lead to a more lasting agreement.

* * *

The American Sugar Consumption.

The American sugar consumption for the first half of 1925 is not yet officially published. Messrs. Willett & Gray, in surveying the situation prior to the official announcement and basing their remarks on their estimate that the figures just exceed three million tons, have drawn their customary comparisons with previous years. In 1924 this six-monthly consumption amounted to 2,680,950 tons, in 1923 to 2,593,691 tons, and in 1922 to 2,671,953 tons. This years's figure is the largest one ever shown in the records, and a remarkable feature of its attainment has been the quiet and orderly manner in which this quantity has been distributed. The refiners have tended during 1925 to increase the carrying of sugar at consignment points, while there has been an increase in the number of such points to which refined sugar is now regularly consigned. The possibility seems then not precluded that the invisible supply has been considerably augmented, and that the figures of "consumption" include an abnormal proportion of such invisibles.

However, time will show whether there is any great disparity between the consumption of the first half of the year and that of the second half. Messrs. Willett & Gray observe that it is rare for the consumption of the second six months to show up as well as the first half of the year, and a table they compiled in a recent issue giving the U.S. consumption for 10 years past in six-monthly periods shows that on the average the decrease in consumption during the second half of the year is about 16 per cent. Using this average figure as a basis, the indicated consumption for the second half of 1925 would be approximately 2½ million tons, making a total consumption for the whole year of 5½ million tons, which would be easily a record. The nearest approach to that figure was in 1922, when 5,092,758 tons was consumed in the States.

It is to be hoped that this estimate may be borne out, since that would be an important factor in steadying the tendency of increased production to lower the price of sugar to an unremunerative level. Sugar producers, at all events within the British Empire, are greatly concerned at the low price levels ruling to-day. Natal for instance has lately seen South Africa importing foreign sugars, and would not be averse to a dumping duty being imposed; as it is, the Union

Board of Trade has been asked to investigate the situation. And Australia, as we mentioned last month, stands to be mulcted heavily if sugar prices on the world's market fall much more As for the West Indies and Mauritius, prices are ceasing to be remunerative, and but for Imperial preference we fear the outlook would be more or less critical But fortunately consumption is tending to increase too, and the opinion is held in some quarters that at the end of the year the visible supplies will be on the small side and will not hamper the sale of the new crop sugars. *Facts about Sugar* takes the view that the Cuban carry-over will be less than 250,000 tons and may be reduced still further by being transferred to stocks in refiners' hands In the United Kingdom the Board of Trade figures of consumption for the first half of 1925 show that 804,787 tons was absorbed, as compared with 773,804 tons in 1924 and 732,609 tons in 1923 This increased amount though welcome is still far from our full capacity, taking the extent of the population and its taste for sugar into consideration, but till trade is better and there is less unemployment in this country, one can hardly look for any marked increase in our use of sugar

The American Sugar Import Duty to be maintained.

The American President has recently had before him the report of the United States Tariff Commission on sugar and has decided that the claim, that the existing rate of duty is higher than the actual difference between the cost of production in the United States and in Cuba is not fully made out, and that indeed differences in cost of production are not sufficiently established under present conditions to warrant any change from the present duty The President also affirms that the interests of the consumer will be best served by the existence of an ample supply of sugar which can only be assured by the maintenance of the indigenous beet sugar industry This apart he considers that American agricultural production is to-day ill balanced, there being too great a cultivation of wheat and other commodities, that are destined for foreign markets over which the U S holds no control while sugar, which the American consumer has to import in large quantities, is treated as of secondary importance The American Department of Agriculture has advised the President that if the beet industry continues to be protected, there is suitable land capable of producing quantities of sugar far in excess of the American domestic requirements It is therefore desirable that the excessive wheat acreage should be reduced if possible by the substitution of beet-root cultivation, and with this end in view it is not surprising that the President has refused to accept the recommendations of the majority report of the Commission (which proposed that the import duty should be reduced by 30 per cent), and has decided to postpone action, which means that till conditions materially alter in American sugar economics the present import duty is appropriate and will be maintained

Africa and Sugar.

To all students of the world movements of sugar it comes as a surprise, sooner or later, that Africa generally has never taken any part either in production or consumption of this product It is true that, in the westward migration of the plant from its home in India and the East, the Moors carried it along the northern coast of Africa but no great development ever took place there In Egypt a certain amount is grown to the present day in the Nile valley, and at the opposite extreme in Natal a promising industry has arisen during the last quarter of a century But both of these countries are outside the tropics, and have to be content, after years of experiment, with second-class, thin and hardy canes of the Indian alliance For the rest, we know from the records of early explorers that the warmer and moister portions of the continent are permeated by thick tropical varieties; but in no part, save latterly in Mozambique, are these grown in mass cultivation for the production of sugar. In the north SCHWEINFURT, in his exploration of the Bahr-el-Ghazal basin, came across thick sweet sugar canes in a semi-wild condition, as soon as he entered the tropical zone bordering the Congo basin; and in the south LIVINGSTONE, when he travelled into the upper Zambesi region, likewise found sugar cane in a similar condition soon after entering the palm belt.

It cannot be held that the African is averse to the consumption of sugar, for it is readily appreciated whenever obtainable, either in the form of a fruit or as a crude raw product; nor can the absence of suitable labour be advanced in explanation, because for centuries the industry in the New World was dependent on this very labour in the form of slaves drawn from the west coast of Africa. It is simply another example of the evidence which has accumulated that Africa is still largely undeveloped as to communications, irrigation, agricultural knowledge, industries requiring capital, and the exploiting of markets. All of these defects are being rapidly corrected; and it is perhaps time for the sugar industry to seriously consider the problem of interesting the African native in this product, especially as there appears to be a promise of an early overtaking of demand by production in the world's market, with an increasing competition for new consuming centres everywhere. It is fair to assume that there is in Africa a huge potential market for sugar, and it is a question whether that continent, with its immense areas of dry and desert land, will ever be capable of being self-sustaining as regards this important food. These thoughts, which have occupied our mind for a number of years past, have received an impetus to expression, after reading an interesting report referred to on another page of this issue on the prospects of establishing a sugar industry in Uganda. Except on the west, the parts of Africa most suited for sugar cane cultivation are generally far removed from the coast; and, for the present, the lack of communications stands in the way of any great advance in propaganda work. In these circumstances the development of small, local concerns for the production of a crude raw material, advocated by the writer of the report, appears to be the most promising line along which to attack this interesting problem.

Sugar in Argentina.

According to the *Monthly Review* of the Bank of London and South America Ltd., the Tucuman cane harvest was proceeding apace at the end of May but had suffered interruptions following on heavy falls of rain and encountered the usual difficulties in transporting the canes to the mills over the sodden ground. Prospects of a profitable season are not particularly bright, owing to the competition of cheap imported sugar. Over 50,000 bags of sugar were landed from Germany during May, and further orders are in hand, while it is also regarded as probable that Cuban sugars may be offered at prices attractive to the Argentine market. It should be borne in mind that though the local consumer of refined sugar has a marked preference for the Tucuman cane product, which is of excellent flavour and appearance, the growing industrial uses to which sugar is put in Argentina to-day do not view the question under a similar aspect. For jam-making, preserves, sweet liqueurs, and confectionery in general, price is naturally the prime factor; and this accounts for present quotations of $3·75 (paper, say 5s. 6d.) per 10 kg. (about 27s. 6d. per cwt.) for moist granulated on wagon at the mill, and $4·90 for refined (pilé).

Fifty Years Ago.

From the "Sugar Cane," August, 1875.

Anything of the nature of an innovation appears to have been distrusted "Fifty Years Ago," and in this issue of our predecessor it was necessary to have an account of experiments by J. SPENCER HOLLINGS proving that maceration was advantageous. He estimated in a simple manner in a small mill the extraction after a first crushing, by weighing juice and bagasse, saturating the bagasse with a weighed quantity of water, recrushing the saturated bagasse, and again weighing juice and bagasse. His figures showed an extraction in the first milling of 13·97 and one in the second of 0·75 per cent.

Some notes (certainly by a partisan) were contributed on the history of the diffusion process as applied to the extraction of juice from the cane, some of his remarks being as follows: "Since this time (1864-1865) under the protection of patents, this method has been introduced into most European countries; but it was only in 1866 that the diffusion process was applied to sugar cane in Aska, Presidency of Madras, East Indies. Mr. MINCHIN, manager of the Aska Sugar Works went to Europe to have the machinery constructed. The cutting machines had to be invented, as those in use for the beet were useless for cane. No one can form an idea of the difficulties Mr. MINCHIN encountered . . . . Notwithstanding all this, he was able at the Exposition in Paris in the next year, 1867, to establish a perfect success, and he was the only one who obtained the great Gold Medal in this branch of industry. Since that time he has succeeded so well with this new process that he and his brother have been able to buy the Aska Works . . . . It must be stated that the process . . . . is an ideal one, which is considerably modified in practical working. One part only is certain, that a vessel is never discharged unless it has the fresh water passed through it several times, which ensures nearly complete exhaustion, so that the cane slices do not give the slightest evidence of containing saccharine matter . . . ." An account is then given of the introduction of the process into Louisiana at a mill known as Belle-Alliance, and again the writer gives a somewhat extravagant account of the results which are stated to have been obtained.

It is of interest here to draw attention to a patent for the production of what is now known as "active carbon." Claim was made for the method of making a substitute for animal charcoal by intimately mixing 30 to 50 parts of lime, finely pulverized and only slightly slacked, with 100 parts of coal tar, and retorting this at a red heat.

Lastly, there is a paragraph in this issue of the *Sugar Cane* from a West Indian correspondent, which may again be reproduced by us, by reason of the hint there given, one which may still be taken advantage of by our readers. "Before the *Sugar Cane* was published, there was no means of gaining any knowledge on cane-growing and sugar-making other than one's own practical experience. It would conduce greatly to the diffusion of the required knowledge if planters would devote a few moments occasionally to penning their experiences, as there are many simple things known in one island which in a neighbouring one no one dreams of."

The Standard Bank of South Africa Monthly Review states that the latest reports from Natal indicate that the new cane crops are presenting a healthy appearance. Final estimates of the crop yield are not yet available, but it seems generally expected that it will be at least 200,000 tons, as compared with 161,000 tons last season. Several mills started operations in May, and crushing was general by the beginning of June. Stocks of last season's sugars are now practically exhausted, and it is expected that all grades of new sugars will be much in demand. Unless, however, there is a sharp recovery in overseas values, opening prices will probably be lower than those ruling at the end of the old crop.

The British Beet Sugar Industry.[1]

A Survey of its Recent Development.

By **ALFRED WOOD,**
Sec., British Sugar Beet Society, Ltd.

The British Sugar (Subsidy) Act became law on March 27th last, and it is now possible to survey the development of the sugar beet industry following its enactment. The Act has been passed with a measure of agreement among all political parties. State Assistance to the industry was first granted by a Liberal Premier. The Coalition Government remitted the Excise Duty. The subsidy proposals were the scheme of the Labour Government. The Act which implemented these proposals was a Conservative one. The sugar beet industry has been taken above party, and the British Sugar Beet Society, which through its 10 years' history has refused to assume a party complexion, has the honour of direct representatives on its Committee of all the three political parties, nominated by their Leaders, to watch and guide its proceedings.

The terms of the Subsidy Act are now familiar to everyone. The general public, however, find it difficult to measure relatively the substantial sums from the Treasury which the 10 years' subsidy involves. These figures are better understood if calculated on the basis of lbs. in weight. When the excise duty was remitted in 1922, the import duty on sugar was 2¾d. per lb. Mr. SNOWDEN reduced this duty by 1½d. per lb. benefiting the consumer by over twenty million pounds sterling per annum. If 50 factories each produced 5000 tons of sugar per annum for the whole period of 10 years, the State assistance to the industry, calculated upon our total average consumption of sugar would not exceed one farthing per lb., before deduction of excise duty. The taxpayer therefore received a relief of 1½d. per lb. upon the sugar he consumes, and under the British Sugar (Subsidy) Act undertook to return to the Treasury for the benefit of the sugar beet industry during 10 years, up to ¼d. per lb. of that relief. In the meantime he has further benefited by a fall in the world price of sugar of over 1d. per lb.

The Act establishes a principle long accepted in Europe, but only recently recognized in this country, that beet sugar production is less a consumer's question than an agricultural one. Sugar is the by-product of an improved farming system. Sugar beet cultivation abroad forms the basis of the agricultural programme, the mainstay of rural employment. It has been said that the subsidy is given to sugar manufacture and not to sugar beet growing. The actual facts disprove this. If the factory, without State help, is to sell its sugar profitably at world prices, it must secure its beet at the prevailing Continental prices. Last year the three factories worked 182,000 tons of beets for which £480,000 was paid to the farmers. The price paid was approximately 20s. per ton more than the Continental price, so that nearly £200,000 was included in the beet payments which, if not secured from the subsidy, could only have been paid from capital. The subsidy must be earned by producing sugar. To obtain sufficient beets, a high extraction, good quality of sugar, and a favourable market price are the risks of the manufacturer. The risk of the farmer, protected by a guaranteed minimum price, is that of yield.

A further principle established by the Act is that 75 per cent. of the machinery employed in a new beet sugar factory or installed in an old factory must be of British manufacture. This condition, designed further to increase employment, was at first viewed with some misgiving. It fettered the liberty of the manufacturer in the choice of his tools, with which he had not only to earn the subsidy, but continue his work after the subsidy ceased. Delays in deliveries might cause new factories to lose the race with a growing crop. This statutory condition is, however, working satisfactorily. The power of dispensation given to the Minister of Agriculture to meet special difficulties has maintained confidence while efforts were being made to meet the new condition. Remarkable enterprise has been shown by British engineers in the organization of their works and preparing the necessary plans and patterns for expeditious manufacture of sugar machinery on a time-limit programme. The dispensation has not been asked for, except for commitments made prior to the passing of the Act.

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[1] The substance of a speech made before the Cheshire Chamber of Agriculture.

The present development of the industry is encouraging. Last year three factories were operating. This next season 10 factories will be producing sugar. Apart from substantial extensions to the older factories, £1,826,000 is being spent upon the building and equipment of the new factories, of which 85 per cent. is being expended in this country. Of this sum £1,035,800 is being spent in British engineering shops. In addition, upwards of three thousand men are employed in factory erection. The capital raised to build and operate these factories is nearly three million pounds sterling. Five further factories are contemplated for the 1926 season.

Last year 22,637 acres of beet were grown. This year over 60,000 acres of beet are being grown—an increase of 160 per cent. upon last year. These should provide over one week's supply of our sugar requirements. Reports from the agricultural areas are favourable. The crops have received greater attention than hitherto. The advantages of early singling to increase yield are being realized. If satisfactory climatic conditions accompany the subsequent growth the yield should be good.

The Prime Minister, one of the earliest members of the Society, said in a recent speech that there was nothing which a Government might more hopefully explore than to see if there might be some method of stimulating even more quickly the erection of beet sugar factories. The British Beet Sugar Society therefore takes this opportunity of setting out the principal difficulties which will retard the industry's growth, and are actually prejudicing the investment of capital in new factories. These are (*a*) the shortage of beets to work the factories at full capacity, (*b*) the shortage of labour, notably at the critical periods of hoeing, singling and harvesting, (*c*) the prohibitive carriage rates to existing factories for beets grown by farmers in areas not yet served by factories, until each area is able to carry a factory of its own, and (*d*) the inclination to build new factories too close to each other, particularly in districts where experience in sugar beet cultivation has already been gained. The solution of each one of these questions will go a long way to solve the others, and the Government, without statutory intervention, can give strong and effective support to the industry in arriving at a solution. Farmers who grow beet, about one-tenth of their root shift at present, would increase their acreage and many new growers would be secured, if the additional labour was guaranteed to them. The labour is there, especially in an unemployment situation of great gravity, and farmers should exert great pressure upon the Labour Exchanges until the provision of efficient farm labour with suitable housing accommodation at seasonable periods becomes a regular feature of labour organization for agriculture. Some figures which I obtained when at the recent International Congress of Agriculture at Warsaw may be interesting in this connexion. The Polish Republic, which has 73 beet sugar factories, and 403,632 acres under beet has an average population, urban and rural, over the whole country of 29 per 100 acres. The total population of Germany averages 51 persons per 100 acres. According to the Census of 1921, the corresponding figure for England and Wales is 98 persons per 100 acres. Taking the agricultural area alone, 29 persons live upon the land per 100 acres in Poland and 20 persons in Germany. The area in England and Wales of arable land and grass is 25,876,797 acres. According to the most favourable figures in English records, not more than 3,764,506 persons live upon the land, an average of 14 persons per 100 acres. In comparison with Germany, therefore, there is a shortage upon English agricultural land of at least 1,500,000 persons or upwards of 300,000 families, in spite of the fact that this country is nearly twice as thickly populated as Germany.

Cane Varieties grown in the Hawaiian Islands.

The cane varieties grown in any important sugar tract are always of interest, and especially where a series of changes have been a marked feature during the development of the industry. Such changes appear to have always been noticeable in a considerable degree in Hawaii and, what is more interesting, appear by no means to have ceased: opinions seem to be divided as to what varieties or even classes will ultimately survive in this remarkable sugar country. Taking at random such figures as are available, it is both interesting and instructive to record some of the changes that have taken place during the last decade and a half. **Geerligs** writes as follows somewhere about 1910: "The cane varieties most prevalent in the Hawaiian Islands are Lahaina, Yellow Caledonia and Rose Bamboo, while a few seedling cane varieties from Demerara are cultivated or on trial. In Oahu and Maui, Lahaina is almost exclusively cultivated, and Yellow Caledonia is in evidence in Hawaii, while the Kauai plantations plant both these kinds, together with Rose Bamboo."[1]

In 1920-1921 the following figures are recorded[2] of the Hawaiian varieties grown on over 1000 acres: Yellow Caledonia 107,334 acres, Lahaina 43,499, D 1135 23,510, H 109 20,616, Striped Tip 5604, Striped Mexican 4938, Yellow Tip 4728, D 117 4658, Rose Bamboo 3298, H 146 1462, Yellow Bamboo 1357.

The industry appears to be still unsettled as to the varieties to be grown to the best advantage; but the tendency to-day is clearly traceable on a perusal of a paper on "Cane Varieties in Hawaii, 1924 Plantings," by W. P. **Alexander**[3] printed last year. This paper is divided into two parts, the first and smaller section being devoted to commercial plantings and the second to experimental; as the trial of local seedlings and varieties is, in its early stages, more or less a matter of purely local interest, the first part of the paper alone is here dealt with. The author treats his matter geographically and, in place of the total acreages given above, deals with each island separately and in the case of Hawaii each district. It must be conceded that this method of treatment fully justifies itself, in that one obtains a much better idea of the particular value of the varieties entering into competition in Hawaii, whether as regards elevation, warmth or moisture—matters of considerable interest to outside readers.

The method of judging the changes which are taking place has also been improved because, in place of the gross areas under the different varieties in the different tracts, details are given of the acreage of each commercial variety ploughed out during the year as contrasted with that planted afresh. Presumably the cane, once planted, is grown in Hawaii for a series of years before being ploughed out, and thus a study of the figures will give a record of the accumulated experience in each tract of the behaviour of any variety during a stated period and the direction in which a change is desired. Much safer deductions can thus be drawn as to the changes of opinion taking place than by the more usual comparison of the acreages under each cane during two consecutive years. Incidentally, it is interesting to note that the author feels himself safe in forecasting the line along which the greatest economic advance may be expected to take place. Contrary to the opinion frequently expressed during recent years, that the commercial success of the sugar industry may possibly be best secured by the increased planting of heavy yielding, resistant varieties with inferior juice, ALEXANDER "basing his opinion on the results secured from H 109, feels justified in stating that the greatest opening for advancement on the agricultural side of the industry is through the breeding and selection of the best varieties." It appears to us to be quite probable that the future will see both of these lines developed because of local differences, e.g., between Oahu and Hawaii islands.

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[1] "The World's Cane Sugar Industry, 1912." [2] *Louisiana Planter*, 1920, October 9th, p. 139.

[3] Presented at the Third Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, October 27th, 1924.

A summary of the mass of figures presented in this paper is appended below, but, stimulated by the remark quoted above, we have ventured to analyse the whole series of figures independently, for the benefit of the general reader. It must of course be remembered that the ploughing out of any variety is a purely routine practice, and of itself merely indicates the extent to which the variety is valued and grown, also, that the acreages ploughed out do not altogether tally with those freshly planted, because of fallowing, etc. In fact the total number of acres given as ploughed out falls short of those replanted by about 5000 during the year under review. The figures are also admittedly incomplete and deal only with plantations which have sent in the necessary returns, but it may be assumed that the results obtained are fairly representative. With these cautions the following totals of the more important commercial varieties will, it is thought, be interesting. In each case two figures are appended to a variety, the first being the number of acres dug out and the second of those planted: H 109 2013, 14,416, Tip Canes 472, 3969, D 1135 1676, 3302: all of these canes appear to be gaining in popularity. The following appear to be receding in favour: Yellow Caledonia 9436, 3117, Lahaina 4001, 111, Striped Mexican 458, 264, D 117 925, 20, Bamboo Canes 637, 4, H 146 475, 0, H 227 138, 0. Lastly, among new varieties, Badila shows 37 acres ploughed out and 150 planted, while Uba has come into cultivation to the extent of 133 acres.

And here the value of ALEXANDER's geographical treatment is demonstrated. H 109 gained 12,528 acres in Kauai, Oahu and Maui where irrigation dominates, and lost the little hold it had in Hawaii which is unirrigated to the extent of 277 acres dug out and only 52 planted. The Tip canes gained in Kauai 2525 acres and nearly 1000 in Hawaii, but are not apparently being grown in Oahu and Maui, possibly because of the lower elevation of the estates. D 1135 gained some 3000 acres in Hawaii and lost over 1000 in the other three islands, in the latter case presumably owing to the competition of H 109 for the low lands under irrigation. Yellow Caledonia lost over 6000 acres in the three northern islands, while it held its own in Hawaii. Lahaina is obviously no longer a serious item and will presumably soon disappear from the list entirely; it does not appear to have been grown to any extent in Hawaii, and the acres dug out elsewhere probably refer to plantings made years ago.

The following are the details extracted from the body of **ALEXANDER**'s paper, the figures in each case being succeeded by some of his remarks. The percentages are those of the total number ploughed out or planted in the tract.

Kauai (11 plantations reporting).

	PLOUGHED OUT.		PLANTED.	
Yellow Caledonia	4875 acres	or 75 per cent. ..	276 acres	or 4 per cent.
Lahaina	520 ,,	8	0	
D 1135	516 ,,	8	222 ,,	3
H 109	386 ,,	6	4239 ,,	55
Yellow Tip	0 ,,	—	2462 ,,	32
H 146	124 ,,	2	0	—
Badila	24 ,,	—	118 ,,	—

The outstanding fact in Kauai is the replacement of Yellow Caledonia and D 1135 by Yellow Tip. All the plantations on the north-east side of the island have begun filling their unirrigated lands with Yellow Tip, "as its vigour, stand and rate of growing all point towards a decided eclipse of the old reliable Yellow Caledonia." As in Oahu and Maui, H 109 is fulfilling all the requirements where irrigation is practised, replacing Yellow Caledonia, Lahaina, D 1135 and H 146. Badila shows a slight increase but is not very popular for several reasons, the chief of which are its low fibre content and susceptibility to rat damage. Among the new Hawaii seedlings, H 456 is planted on 73 acres and its ratooning characters are being observed.

Oahu (7 plantations reporting).

	PLOUGHED OUT.		PLANTED.	
Yellow Caledonia	1679 acres	or 34 per cent. ..	57 acres.	
Lahaina . ..	1538 ,,	31	3 ,,	
H 109	616 ,,	12	4958 ,,	or 98 per cent.
D 1135..	608 ,,	12	0 ,,	
H 146	257 ,,	5	0 ,,	

H 109 is thus beyond all doubt the standard variety in Oahu, and there will soon be none of the older ones left. At Ewa plantation, 616 acres of this variety ploughed out were replanted with it again, showing that this cane has no rival in the island. H 8958 was planted on 2 acres at the Oahu Sugar Company's plantation, and Wailuku No. 2 on 5 acres at Kahuku.

Maui (5 plantations reporting).

	PLOUGHED OUT.		PLANTED.	
Lahaina	1943 acres	or 51 per cent. ..	108 acres	or 2 per cent.
H 109	734 ,,	19	5166	91
Striped Mexican..	454 ,,	12	258	
D 1135..	235 ,,	6	71	
Bamboo	221 ,,	6	0	
Yellow Caledonia	123 ,,	3	0	

This stronghold of Lahaina has obviously fallen to H 109, while Striped Mexican, H 146, D 1135, Bamboo, and Yellow Caledonia are being rapidly discarded. Badila is planted on 25 acres, and of the newer seedlings, Wailuku Nos. 2 and 4, are finding favour on a small scale.

Hawaii.—This island is divided into Kau, Hilo, Hamakua and Kohala districts and these are separately and more or less incompletely reported, the numbers of estates sending in returns being 2, 5, 5, and 2 respectively. The varieties grown appear to differ somewhat widely from those in the other three islands, in that H 109 has no place, D 1135 and Tip are on the whole increasing, while Yellow Caledonia is about holding its own, according to figures given by **ALEXANDER**.

Cane Varieties grown in the Hawaiian Islands.

Kau district (2 plantations).

	PLOUGHED OUT.		PLANTED.	
Bamboo	416 acres	or 83 per cent.	0	—
Striped Tip	60 ,,	12 ,,	0	—
Yellow Caledonia	25 ,,	5 ,,	492 acres	or 47 per cent.
D 1135	0 ,,	0 ,,	544 ,,	53 ,,

D 1135 and Yellow Caledonia continue to remain the standard varieties. At Pahala (highest elevation) Yellow Caledonia has given 70 tons of cane at 2000 ft. and D 1135 the same yield at 2600 ft.

Hilo district (incomplete).

	PLOUGHED OUT		PLANTED	
Yellow Caledonia	1343 acres	or 90 per cent.	1936 acres	or 79 per cent.
D 1135	0 ,,	0 ,,	399 ,,	16 ,,
H 227	125 ,,	8 ,,	0 ,,	0 ,,
Tip canes	29 ,,	2 ,,	82 ,,	3 ,,

On the *Makai* (lower) lands no cane has been found to equal Yellow Caledonia for the greater part of the district, where it has been planted for the past 20 years. No complaint is made of its virility, taken as a whole, and no seedling has been found to equal it.

In the *Mauka* (upper) lands D 1135 and Yellow Tip are considered the best, although considerable difference of opinion exists as to their respective merits. A number of seedlings are being tried, as well as Badila, and some of the seedlings have passed the experimental stage although only planted sparingly at present (totalling about 2 per cent. of the plantings).

Hamakua district (5 plantations).

	PLOUGHED OUT		PLANTED	
Yellow Caledonia	1096 acres	or 45 per cent.	355 acres	or 12 per cent.
D 117	925 ,,	38 ,,	12 ,,	0
D 1135	210 ,,	9 ,,	1740 ,,	61
Striped Tip	118 ,,	5 ,,	654* ,,	23
H 109	100 ,,	4 ,,	0 ,,	0
Uba	0 ,,	0 ,,	66 ,,	2

The choice of varieties in this district depends largely on elevation and the prevalence of mosaic disease. Yellow Caledonia is not much planted above 600 ft., but D 1135 both in low lands and up to 1200 ft.; Yellow Tip is in favour for the highest lands, except where mosaic is present; Uba is being tried in high diseased areas and, as heavy yields of cane have been obtained in comparison with D 1135, it may be regarded as having passed the experimental stage. Several seedlings have also appeared on or above the horizon, including a Uba-D 1135 hybrid now planted on 4 acres.

Kohala district (incomplete).

	PLOUGHED OUT.		PLANTED	
Yellow Caledonia	295 acres	or 35 per cent.		
Tip canes	265 ,,	31 ,,	708 acres	or 65 per cent.
H 109	177 ,,	21 ,,	50 ,,	5 ,,
D 1135	107 ,,	13 ,,	326 ,,	30 ,,

No great change has occurred in this district, but the presence of occasional dry spells reacts against H 109 which needs irrigation. Even Yellow Caledonia "is not able to withstand drought as once it did." D 1135 for the middle and lower sections and Tip canes for the upper compose the plantings but, as mosaic is present and Tip canes are liable to be attacked, it is important to find a substitute for them. An experimental area of 1½ acres is being tried under Uba.

C. A.B.

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* Yellow Tip.

A Method of handling Cane Tassels for Breeding Work.

By J A VERRET, in collaboration with Y. KUTSUNAI, U K DAS,
RAYMOND CONANT and TWIGG SMITH,
of the Hawaiian Sugar Planters Experiment Station

During the present breeding season we developed a system of handling cane tassels for breeding which gives promise of being of tremendous help in the work of crossing and selfing cane varieties.

None of the methods used heretofore were wholly satisfactory Emasculation is, of course, out of the question The bagging method, the method mainly used in this work when accurate results were desired, is not satisfactory for several reasons If cloth heavy enough to prevent the entrance of foreign pollen is used, the shading seems to weaken the tassel greatly, and poor or no germination results If the cloth is too light one has no assurance that other pollen has been kept out, so the object of the work may be defeated.

On account of these unsatisfactory results the majority of cane breeders working on a large scale have resorted to the so-called "tying-on-of-tassels"

All breeders are familiar with the details of this method and we shall not describe it It involves a great deal of work, requiring the continuous change of tassels and, of course, no great protection against foreign pollen Under the best conditions the cut tassels soon die. So in order to have good fresh pollen on the stigmas in their most receptive stage some breeders change these tassels in the night, generally from 2 to 4 a m.

Our method consists of the use of a certain solution which keeps the cut tassels fresh and developing normally for a long period of time The method is not by any means perfected yet, as we have but recently started its use on cane tassels But we feel that by making it public now other breeders can do work with it and in that way hasten its perfection

After conducting a large number of experiments (one hundred or more) with all kinds of preservatives and other solutions, we found that by placing the cut end of a cane stalk, with or without a tassel, in a solution of sulphurous acid (SO_2), 1 part in 2000, it will keep alive, in apparently normal condition, for several weeks After being once placed in the solution no further attention need be paid to the tassel except to see that it does not grow beyond reach of the tassel to be pollinated

Microscopical examination of pollen from tassels cut from one week to ten days shows no differences from pollen from fresh tassels. We have obtained germinations from pollen taken from a tassel cut five days before, as shown in the following record by C. C BARNUM, of the Pathology department

TASSEL CUT NOVEMBER 7TH, 1924

On November 11—pollen collected 12 noon—germinated
On November 12—pollen collected 1 p m —germinated
On November 12—pollen collected 4 p m —germinated
On November 13—pollen collected 8 a m —germinated

TASSEL CUT NOVEMBER 17TH, 1924.

On November 20—pollen collected 9 a.m.—germinated
On November 20—pollen collected 4 p.m.—germinated

It is very difficult to get cane pollen to germinate under any conditions, so the getting of these germinations of pollen from cut tassels shows the pollen to be good.

A Method of handling Cane Tassels for Breeding Work.

As showing that the cut tassels kept in the sulphurous acid solution develod normally, we have the following:—

On October 21st, three tassels were cut at the Manoa substation (these were the first tassels of the season) brought to the main office and placed in the solution at once. When cut, the tassels had not fully emerged and no stigmas or pollen sacs were out. These tassels were of the same variety and were kept isolated in a greenhouse. On November 6th, the tassels had matured and the fuzz was planted. On November 12th, we obtained germinations.

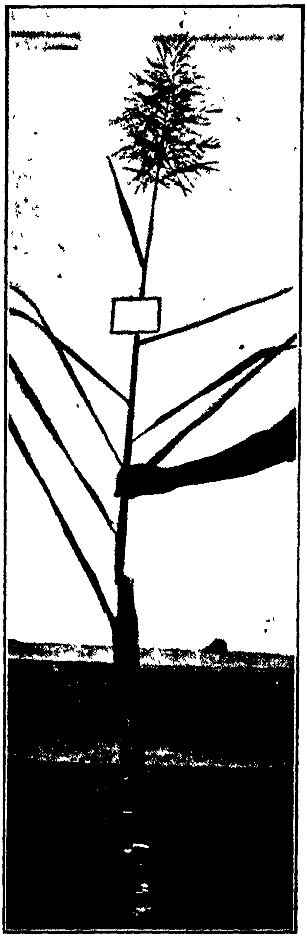

FIG I. This stalk has been in the sulphurous acid solution one week Flowers are still opening and are giving good pollen.

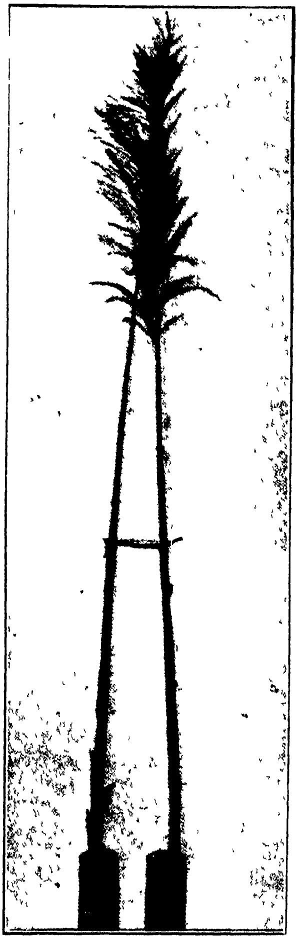

FIG II Method used in obtaining crosses by means of the sulphurous acid method Tassels of the varieties to be crossed are placed in the solution and kept in a sunlit pollen-proof room. In the early morning the tassels are shaken to scatter the pollen When mature, all tassels are planted

These results offer great possibilities in crossing and selfing work. If tassels so handled give good germinations it will be a simple matter to so isolate them as to be sure no other pollen has contaminated them.

In our work with the sulphurous acid solution we have found there are several things to be especially guarded against. One is to be sure that the sulphurous acid solution does not contain sulphuric acid. This may be the case *with old solutions which have been exposed to the light. If any sulphuric acid be present the work will result in failure.*

The next precaution to take is to have a solution of the proper strength. The solution should be strong enough to prevent turbidity, but not be so strong as to burn the leaves: in other words, the weakest solution that will prevent turbidity. We find a 1 to 2000 freshly prepared solution to be satisfactory. It is possible that it can be somewhat weaker than this.

We find it more satisfactory to prepare our solutions ourselves with SO_2 gas. We prepare a 5 per cent. SO_2 solution by slowly bubbling the gas through water. This is diluted as we want it, 1 c.c. to 100 with water. Fresh stock solutions are made every week or so.

Another precaution for successful work is to place the tassel in the solution at once. When getting tassels some distance from headquarters, the cut ends are put in water immediately after cutting. On arrival, where they are to be used, one joint is cut off under water and then the tassel goes to the solution at once, where it must remain continuously. Unless this is done failure generally results.

We leave from 2 to 4 ft. of cane stalk with each tassel. The sugar in the stalk apparently is used for food by the plant in the solution, as at the end of two or three weeks or in some cases longer, there is no sugar left in the stalks.

The methods in use here previously and the various steps that led to the development of the new method are given briefly in the following paragraphs.

Heretofore in our work here the pollen-bearing tassels of sugar cane for artificial pollination have been obtained some distances away, brought to the Station grounds, and treated somewhat as follows :—

The lowest joint was cut away under water. The tassels were transferred to a container with clean water, taken to the female tassels or left leaning on a table so that the pollen grains could be utilized. The water in which the tassels were left standing was changed once or twice a day.

The changing of the water was found rather difficult in some of the high cages, and sometimes the waste water was poured accidentally on important tassels. To obviate this difficulty experiments were started to find a method suitable for keeping cut tassels alive and growing for say a week to ten days without changing water.

The drying of the cut tassels was thought to be due to clogging up of tubes through which water was taken up or by toxic substances in the water. This clogging could be brought about by some organisms in the water or in the cane stalks, by the suspended matter in the water, or by some decomposing material of the sugar cane itself.

From past experience, it was suspected that the growth of some sort of organisms in the water was responsible for the early death of cut sugar cane, and the source of these organisms was thought to be the surface of the cane. Hence, the first part of the experiment was to disinfect the cut ends. It was soon found that a dilute disinfecting solution was better than the treatment of the cut ends.

The results so far obtained show two methods of value :—

(1) Lowest joint is cut away under water each day and the water in which the cane is standing is kept clean and fresh.

(2) Lowest joint is cut away under water, and the cane is transferred to a dilute solution of sulphurous acid, 1 part SO_2 gas in 2000 parts tap water. The

solution is changed whenever turbidity is noted. As a general rule we have no turbidity if the sulphurous acid solution is properly made. When it is necessary to change a turbid solution, one may as well change the tassel also, for if it has once commenced to wilt it will not recover.

The following notes by Mr. DAS give a few typical tests made and show the progress of the work to the present time.

In this work Mr. DAS has shown resourcefulness and initiative, and deserves great credit for the results obtained.

The following gives the steps taken in developing the sulphurous acid solution method of keeping cane tassels:—

The tassels are cut with 2 to 4 ft. of cane stalk (joints) on them.

(1) The cut cane is put in tap water, changed every day.

(2) The cut ends are immersed for about one minute in acid and then put in water.

(3) The cut ends are immersed for one minute in alkali and then put in water.

(4) The cut cane is put in a standard nutrient solution.

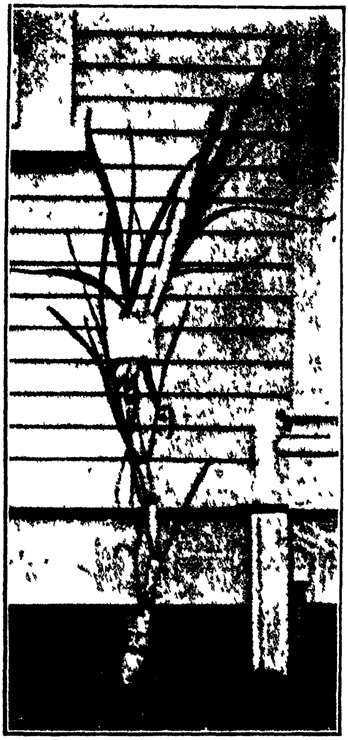

FIG III. This stalk has been in the sulphurous acid solution for over a month The tassel matured, was planted and germinations obtained Note the sprouted eyes All of this growth has occurred since placing the stalk in the solution Selfs may also be obtained in the same way.

The canes all began to wilt and die in two or three days, and slime was detected. The next step was to have the slime examined by the Pathology department.[1] It was found to contain bacteria, protozoa and fungi. Thenceforth, our efforts were directed to controlling the growth of slime or keeping it in check. The first disinfectant used was mercuric chloride (1 in 20,000). This gave a better result and confirmed our belief that slime was an important factor. In another test the cut cane was put in tap water which was changed every day, and each day the bottom joint was cut off, thus exposing a new surface to the clean water. The sticks did very well and we were able to keep them fresh two or three weeks and even longer. We later found that it was necessary to always cut at least one joint every day. It is necessary to cut off a node each time.

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[1] The Pathology department has been of great help in this work At the present time Mr BARNUM is devoting all of his time to a study of pollens and related problems

Mercuric chloride (1 to 20,000) did not, however, come up to our full expectations. We thought it was too strong and we thereafter used more dilute solutions down to 1 in 100,000. There was no growth of slime, but the cane sticks never did very well, or as well as the sticks in water which had one joint cut every day. $HgCl_2$ together with sugar solutions of various strengths and standard nutrient solution was later on tried, but no encouraging result was obtained. Some canes were first sterilized for different periods in $HgCl_2$ and then put in water changed every day, but with the same result.

We then tried cane sugar solution of various strengths, but in all cases the canes began to die in two or three days.

We also used lime water, soil solution and many inorganic salts such as ammonium chloride, magnesium chloride and lead chloride. We tried camphor, ether, chloroform and alcohol in water, but with no success. We then concentrated our attention to finding some mild disinfectant that would not have the killing power of mercuric chloride, but which would be as effective in keeping off the growth of organisms in water. We have tried the following:—

(1) Potassium permanganate—1 grm. in 1000 c.c. of water.

(2) Aspirin—20 grains in 1000 c c. of water.
The cane did fairly well for about six days, but soon after the leaves began to die.

(3) Formalin (40 per cent. commercial product) 5 c c in 1000 c.c
It was too strong; leaves appeared scorched.

(4) Boric acid—0·1 grm. in 1000 c.c. of water,
0 5 grm. in 1000 c.c. of water.

(5) Hydrogen peroxide (commercial product)
250 c.c. in 1000 c c.
143 c.c. in 1000 c.c.
With (3), (4) and (5) the leaves became dry and brittle in one day.

(6) Sodium sulphite—2 grms. in 1000 c.c.

(7) Sulphurous acid (H_2SO_3) various strengths.
Sulphurous acid has proved successful, though we cannot say it is perfect as yet.

The first experiment with sulphurous acid was started on September 15th. The strength used was 1 c.c. of the commercial product (original analysis) 8·3 per cent. SO_2) to 100 c.c. of water. In a day or two it was noticed that the leaves not only kept fresh but there was a marked growth of stalk. This growth continued as long as the stick was alive, though during the latter stages the rate of growth fell off.

The first stick was alive about a week when, through some accidental circumstances, the experiment was lost. However, it gave us very good indications and we tried another batch of new canes. All these stood the test remarkably well, and in all cases the cane was alive for more than two weeks. In one case the stick was alive for about one month and the growth during the period was nearly one and one-half feet. During all these days the solution was not changed, nor was any part of the stalk cut off. As the solution was taken up by the stalks new solution was added to make up. Our attempt was now to find the optimum strength of the solution in which the cane will do its best. We tried the same acid diluted as follows —

0·5 c.c. to 100   1·5 c.c. to 100
1 c.c. to 100   2 c.c. to 100

It was found that while the cane did pretty well in all these solutions, the solutions of higher strengths (1·5 c.c. to 2 c.c. to 100) had some strong effect on the leaves. The solution 0·5 c.c. to 100 turned turbid at the end of eight days and the stick died soon after. So it was concluded that 1 c.c. of the acid to 100 water was the best strength. We then began to apply our experimental results on a big scale and under regular field conditions. Here we were faced with one minor difficulty. The original stock of H_2SO_3 being finished we had to use acid freshly prepared in our laboratories. We found that 1 to 100 of an 8 per cent H_2SO_3 was too strong for the leaves. We then worked down to 1 to 100 of a 5 per cent acid freshly prepared. This time we got the same results as in our previous experiments. The sulphurous acid first used had probably weakened on standing. This probably explained the incongruity in the experimental results. However, we have now given this 1 to 100 of 5 per cent acid a fair trial and are getting fine results. We have been able to keep tassels alive in this solution for two weeks and even more. We have obtained good pollen all the time and some actual germination of seedlings.

We still feel that some more improvements could be made, even on this, and we have been trying it in many other ways. We have also been trying other organic acids and salts and some other disinfectants.[1] But one point especially associated with this H_2SO_3 is its power of stimulating growth. In this connexion, we may mention one interesting experiment we made with ice. The cane put in ice looked fresh, but as soon as ice was withdrawn it died. During these three or four days there was no growth at all.

We learn that the General Thomas & Petree Company, of 69, Victoria Street, London, S.W. 1, in conjunction with Petree & Dorr Engineers, Inc., of 67, Wall Street, New York, have been appointed sole representatives for the Suchar Process Corporation for Mauritius, Reunion, and the Portuguese and British African possessions. The Suchar Corporation own or control the patent rights for "Suchar," the new clarifying carbon, as well as the Suchar Process of white sugar manufacture.

Through "Lumina" spectacles all colours appear as in sunlight. Dr. HERMANN WEIS, of Vienna,[2] recommends them for general work in laboratories where many kinds of work are difficult to perform in artificial light. By their use titration in such light can readily be made even with methyl orange whilst the colour and appearance of crystals and of precipitates can be recognized and described as accurately as in daylight.

The Dominion Bureau of Statistics, Ottawa, has issued a report on the sugar industry of Canada in which the following data are given. Daily capacity of the seven refineries of the Dominion: raw sugar melted, 6,394,580 lbs.; granulated made, 5,253,420 lbs.; soft sugar made, 596,086 lbs.; and syrups, 224,518 lbs. Statistics for 1925: Sugar manufactured, 841,978,637 lbs.; sugar imported, 17,039,979; sugar exported, 119,121,347; sugar available for consumption, 739,897,269 lbs.; *per capita* consumption, 8.46 lbs.

Messrs. Willett & Gray in their preliminary estimate of the United States beet crop for 1925-26 forecast an outturn of 825,000 tons of sugar, as compared with one of 974,185 tons last year. This reduction of some 150,000 tons is attributed largely to adverse weather conditions, early frost and then drought having affected the beet fields.

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[1] Since writing the above we have started a test with Dakin's solution with very encouraging indications.

[2] *Industrial and Engineering Chemistry* (*News Edition*), April 20th, 1925, page 6.

The "Crusher-Shredder."

A New and Original Cane Preparatory Device.

(Contributed.)

INTRODUCTION.

Whereas the crusher and the shredder are cane preparatory machines known to the cane sugar industry for nearly half a century, the "Crusher-shredder" is an invention of very recent date. To be more exact, the crusher was originally introduced in 1882 by THOMSON and BLACK; whilst the first shredder was patented as far back as 1879 by FAURE. The "Crusher-shredder," however, came into being only in 1922 when patents were granted to the inventor, FRANCIS MAXWELL, D.Sc., M.I.Mech.E., F.C.S.[1]

As we know, the crusher is characterized by a pair of grooved or toothed rollers which revolve at the same, but slow, speed (2–3 revs. per min.); whilst the shredder, as is commonly in use, comprises two toothed rollers which revolve at different, and both at high, speeds (from 150 revs. per min. upwards).

The process of crushing and that of shredding are fundamentally different; being, in fact, the opposite of one another. The purpose of crushing, as the term implies, is to bruise and cut or split the cane and thereby extract juice from it. On the contrary, the purpose of shredding is not to extract juice, but to tear and reduce the cane into shreds, and thus render it more responsive to the extraction stages carried out in the subsequent series of mills. In other words, crushing depends upon rolling under great pressure at slow speeds; whereas shredding depends on cutting without pressure between two surfaces running at different speeds, the high-speed roller cutting while "slipping" through the cane against the resistance furnished by the slow-speed roller.

Shredding, in the practical and universally accepted sense of the word, cannot possibly be performed by a crusher, and *vice versa*. The use of separate units for these divergent operations naturally involves many disadvantages, such as expense of construction and maintenance, incompactness of structure, extensive floor face occupied, and so forth. These disadvantages have constituted a problem which had not been solved until Dr. MAXWELL conceived the idea of combining the two operations in one unit. This at once necessitated the complete re-organization of the components of the crusher and the shredder, resulting in the creation of a machine giving an entirely new result, to wit, a machine wherein the elements composing the combination effect not only the initial crushing of the cane and the expression of the juice, but also the shredding of the crushed cane.

The invention of this machine accordingly constitutes a master patent—and indeed is generally acknowledged to be such—and creates a new species of cane preparatory devices for which the inventor has coined the name "Crusher-shredder." The Maxwell machine is, therefore, the first and only machine of this designation in the history of the cane sugar industry.

THE MAXWELL "CRUSHER-SHREDDER."

The principle of the invention which constitutes the basic patent granted to Dr. MAXWELL reads thus: "A machine constituting a combined crusher and shredder for sugar cane, comprising a stand or unit of crushing and shredding rollers, and driving means therefor." The accompanying diagram, Fig. 1, illustrates the *modus operandi* of the Maxwell apparatus diagrammatically.

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[1] U.K. Patent, 198,120; *I.S.J.*, 1923, 499.

The "Crusher-Shredder."

The cane passes from the cane carrier direct into a pair of rollers with coarse teeth moving slowly under heavy pressure. A great deal of juice is at once secured, while the fibre resistance of the whole cane is destroyed by splintering under severe pressure. The matted cane is thus presented in the best condition to the swiftly moving shredding teeth on the third roller towards which the preparatory pair thrust the cane. While the crushed cane is still held in the grip of the slowly moving preparatory rollers it is operated on by the third or shredding roller. The prepared cane is teased, or "combed" into shreds, by the toothed bars which are moving at high speed. Detached pith is tossed out quickly, while the rind, by virtue of its comparative tenacity, receives more severe treatment because it is held in the machine. The shredding teeth pick and cut the pith and rind off the matted cane from the slow-speed rollers and throw the fibrous mass forward in an enclosed casing toward the mills. The juice has fallen clear and is not in danger of re-absorption.

The speed at which the preparatory rollers revolve is that usually met with in ordinary crushers, namely 2-3 revs. per min.; while that of the shredding roller is about 300-500 revs. per min. An important feature of the machine is that the shredding roller is independently driven, and consequently its speed can be regulated to any desired rate, say from 200 to 1000 revs. per min. Therefore the fineness of the shreds is completely under control. It may, however, be observed that Java experience has proved that a shredding speed of about 400 revs. per min. is ample to achieve the best result in subsequent milling.

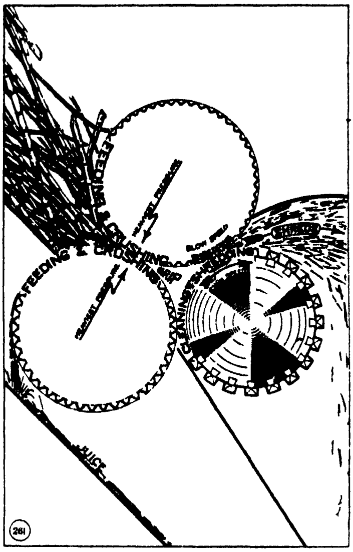

FIG 1

Diagrammatic drawing of the Maxwell "Crusher-shredder."

Fig. 2 illustrates a pile of bagasse produced by the Maxwell "Crusher-shredder" in Java direct from cane (Seedling No. 247, fibre 15 per cent).

Merits of Cane Preparation by Shredding.

The benefit of shredding when reasonably conducted is not open to doubt. The yield of juice is definitely increased, and the extraction of sugar correspondingly raised. The gain will, of course, vary according to the efficiency of the milling equipment which succeeds the shredder and completes the work.

It is evident that in these circumstances the mills become purely wringing or "mangling" machines, being freed from the duty of breaking down the fibrous structure of the cane. The rollers are set very much closer than in the case of milling in conjunction with crushers. The juice comes away with remarkable ease. Thus at the outset the first mill which receives the shredded cane from the "Crusher-shredder" secures much more juice with less power, and the maceration is freer and more efficient throughout the train.

Disc-shredders, although useful under old conditions, do not carry the disintegration far enough. Shreds about ½ in. wide and more are generally produced, and this is not nowadays regarded as sufficiently fine. Modern shredders, on the other hand, are criticized as giving too fine a reduction accompanied with the formation of dust or *bagacillo*.

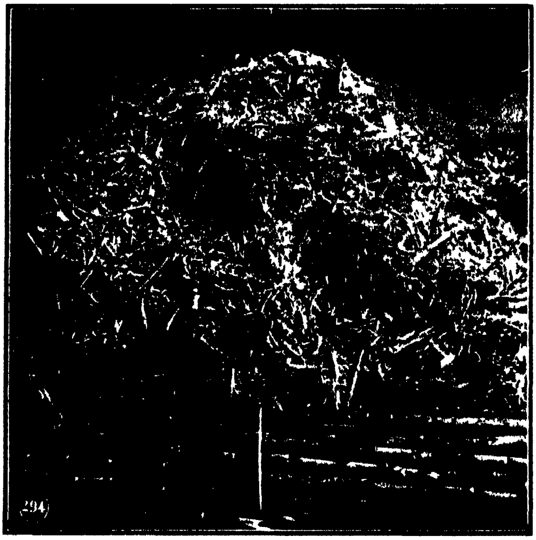

FIG 2
Bagasse produced by the "Crusher-shredder" in Java, from Seedling No 247
fibre 15 per cent
Note size of shreds relative to cane

As the photograph (Fig. 2) clearly shows, the Maxwell "Crusher-shredder" gives an intermediate state of shredding. The degree of disintegration aimed at, and secured, was chosen after a study of other shredders at work and after due observance of the influence of shredding upon other phases of the factory work, notably clarification and power production. Its important advantage over other shredders, as already stated elsewhere, is that the fineness of the shreds is completely under control.

BAD INFLUENCES OF POWDERED BAGASSE.

Everyone concerned in economical work demands cane shredded to a reasonably fine state to secure good extraction and maceration, and also to secure dry fuel. But a point is reached at which the shreds may be so fine as to incur disadvantages, which state is reached when the fibre is pulverized to such an extent that a large amount of dusty particles (*bagacillo*) results, more especially derived from the tender pith. These dusty particles are able to escape with the juice from the rollers and so form a far too voluminous "cush-cush." The juice goes down laden with *bagacillo*, which passes through the sieves and gives trouble in clarification. At the same time, the whole body of the bagasse goes to its final destination at the furnaces in a powdery condition which makes economical burning difficult

The "Crusher-shredder" produces very little dust for the following reasons: The preparatory crushing at slow speed relieves the high-speed element of a very large part of the "punishing" and dust-producing work. The operation of the shredding element itself is moreover novel in that the soft pith is teased or "combed" and tossed out, while the major part of the rind is retained for a longer time by the grip of the slow-speed rollers. The tenacious parts of the cane thus cling by that very property (tenacity) which the machine is intended to destroy, while the less tenacious pith escapes a treatment which would be too severe for it.

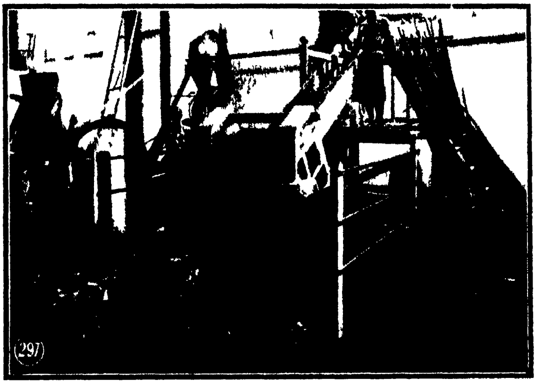

Fig 3
Maxwell "Crusher-Shredder" (trial machine) at work
Note texture of bagasse.

The character of the shredding performed by the new invention is easily discerned in Fig. 2. This bagasse is produced with a shredding speed of about 400 revs. per min. It will be seen that the shreds are uniform and neither coarse nor dusty.

Cost of Maintenance.

Mill engineers are familiar with the severe wear and tear, and the expensive nature of the renewals for "Disc-shredders" of the old type. The discs are in themselves large and expensive castings needing a special process in manufacture. Not only are the castings expensive, but they also need careful boring and grinding on the end faces. Therefore, the expense of the discs is very heavy and forms a recurring charge every crop or two if the machine is to be kept in reasonable order.

Of other types of shredders it may justly be said that the work done is far more onerous than it should be. These shredders pulverize the fibre, which excessive reduction of course re-acts upon the machine, necessitating a large number of replacements.

In the Maxwell "Crusher-shredder" a double cut is made at these expenses. In the first place, the proper degree of shredding is aimed at and secured, thus avoiding heavy power consumption and its attendant wear and expense. In the second place, the parts subject to abrasion are small castings of a simple kind bearing no expense in machinery or fitting. The maintenance in regard to the parts liable to renewal, namely, the toothed bars, is thus in every respect as cheap as can well be devised, and that fact is a potent inducement for the general adoption of the machine. It is shown in Fig. 3.

PRACTICAL OPERATING POINTS.

While in Java, Dr. **MAXWELL** supervised the erection and operation of a demonstration "Crusher-shredder" at the Padokan factory. The operation of this machine was witnessed by a great number of persons, including the majority of the leading sugar experts in Java, who recognized it as a most practical and efficient cane-preparing device.

In order to enable readers to form their own judgment of the Maxwell invention, we give here a few excerpts of testimonials by some of these leading Java experts.

Dr. **PH. VAN HARREVELD**, the Director of the Java Sugar Experiment Station, expressed his opinion thus:—

> "We took much interest in your Maxwell patent 'Crusher-shredder,' which was demonstrated at the Padokan sugar factory at Djokja. The shredder gave a fine bagasse which was well fit for the following mills. The shredder roller got the bagasse directly from the crusher rollers, which enabled a very simple and strong construction. The fineness of the bagasse could be regulated by regulating the velocity of the shredder roller. Though the machine was of a small size for demonstration, we are convinced from the results that the full size machine, which will be set to work in Java next year, also will do its work perfectly."

Mr. **ACKET**, delegate of an important group of sugar mills in Java, with Mr. **F. W. BOLK**, the eminent milling expert who was formerly Director of the Technical Department of the Java Sugar Experiment Station, stated:—

> "Mr. F. W. Bolk's opinion as well as my own regarding your machine is quite good, and goes so far that there was sufficient motive for me to cable to my Board of Directors in Holland to make a proposal for buying a 'Crusher-shredder,' 'patent Maxwell,' to be used on our largest estate 'Gempolkrep.'"

Mr. **J. VAN KOESVELD**, manager of Kaliwoengoe Sugar Factory, and a milling expert of long standing in Java, wrote:—

> "During my long experience I have worked with Ross Cutters, Shredders, Crushers, Toothed Rollers, but was most surprised at the results during the demonstrations at the sugar mill 'Padokan' with your patent 'Crusher-shredder.' 1. Your first roller and top roller crush the cane as well as any other crusher with at least the same extraction of juice. 2. Your third shredder roller gives a better preparation of the cane than I have ever seen with any shredder and still better than with the former splitters in the Ross cutter. 3. The power in your 'Crusher-shredder' machine will be far less than that used in ordinary mill driving. 4. Your shredded cane is so prepared that after passing the first mill it will give full results in imbibition with juice or water."

While in the United States Dr. **MAXWELL** came to an agreement with the Farrel Foundry and Machine Co., of Ansonia, by which this firm has acquired the exclusive licence for the manufacture and sale of the Maxwell "Crusher-shredder" in the United States, West Indies, and South American countries.

The Farrel Company expect to supply installations in the West Indies and Hawaii for operation during the 1925-26 crop. The order for an installation has also been placed with the Sugar Machinery Manufacturing Co., Ltd., of London, for South Africa.

Soil Hygiene in its Relation to Cane "Disease."

By **MAURICE BIRD**, B Sc.,
Berbice, British Guiana.

In the August, 1922, issue of *The International Sugar Journal,*[1] the writer detailed instances of plant diseases being directly traceable to the lack of plant food, to make a vigorous, healthy growth, and he would like now to record a striking example of what at first appeared to be an epidemic, but which was apparently a withering and dying of cane due to what HARRISON years ago very aptly called the "unhygienic condition" of the soil.

At the close of last year, after a fine growing season throughout the autumn, the cane in places on several Estates, with which I am connected, began to wither at the top, growth appeared to cease and death ultimately ensued. As the trouble was too wide-spread to be accounted for by local conditions the matter was referred to the Colonial Mycologist, who after a thorough examination concluded that the cane was not diseased and suggested that the cause of death might be a toxic condition of the soil.

In the meanwhile the writer had been making the following analyses, which we may first tabulate and then discuss.

ANALYSIS OF SOILS FROM AFFLICTED FIELDS.

	Volatile Matter per cent Soil	Ingredients soluble in a 1 per cent solution of Citric Acid.				
		Lime	Magnesia	Potash	Soda	Phos. Acid
1	13 04	0·094	0·004	0·020	0 095	0 004
2	11·92	0 062	0·003	0·010	0·107	0 005
3	12·78	0·108	0·021	0 013	0·146	0 004

ANALYSIS OF SOIL SIFTED FROM AND ADHERING TO THE ROOTS OF DEAD CANE.

Volatile Matter per cent Soil	Ingredients soluble in a 1 per cent solution of Citric Acid.				
	Lime.	Magnesia.	Potash	Soda.	Phos Acid.
16 68	0 070	0 082	0 024	0 021	0 022

ANALYSIS OF THE ASH OF THE JUICE FROM "DEAD" AND "LIVE" CANE.

	"Dead."	"Live"[2]
Silica per cent. Ash	10 83	7 69
Lime per cent Ash	2·74	2·13
Magnesia per cent. Ash	7·63	4·88
Potash per cent. Ash	22·18	20·29
Soda per cent. Ash	1·14	1·26
Phosphoric Acid per cent. Ash	2 81	1·92
Sulphuric Acid (SO_3) per cent. Ash	13·39	14·05

While in the above analysis of soil from withered cane fields the phosphoric acid is on the low side, we frequently find it lower still without any appearance of dying cane; also, the analysis of sifted soil from the roots of dead cane shows such a large amount of plant food as to preclude any possibility of starvation being the cause of death. When, however, we examine the relationship of lime to magnesia, the condition is not so satisfactory.

The widespread belief among sugar soil experts, that an excess of magnesia over lime exerts a toxic effect on cane, suggests that this may account for the withering and death in the case under discussion, for this excess is evident in the soil surrounding the roots of the dead cane, and, to a much greater extent in the ash of the cane itself.

The soil of the affected fields is of an extremely impervious nature, being a very stiff clay; and, apparently, due to the abnormally rapid growth of the cane, the increased demand for lime, for the greatly extended foliage, drew more heavily upon the soil for this element, closely adjacent to the roots, than could be supplied without causing a toxic ratio of lime to magnesia to result. Had the soil been loose and porous, permitting a free circulation of soil water and hence of lime, probably no trouble would have resulted, since the average composition of the affected fields shows a satisfactory ratio of lime to magnesia.

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[1] Page 406.

[2] Much of this cane ultimately withered and died

On the death of the cane, the demand for lime ceasing, the slow circulation of the soil water probably more or less completely restored the equilibrium between the lime and magnesia, for the succeeding crop had "sprung" nicely and has now for several months been growing vigorously and healthily.

If the above is the right explanation of what at one time gave considerable anxiety to the authorities of the estates affected, and there seems nothing to contradict it, then the obvious safeguards, against a recurrence, are such agencies as will render the soil more porous, such as the incorporation of vegetable matter, more thorough tillage of the soil and applications of lime, for the double purpose of flocculating the soil and acting as a reserve in times of abnormally vigorous growth.

I may add that three such "epidemics" are on record in this Colony, each following a propitious season of rapid cane growth.

The original source of magnesia is found when these soils are submitted to hydrochloric acid, the solvent disclosing almost invariably far more magnesia than lime; with a 1 per cent. solution of citric acid, however, more lime than magnesia is, as a rule, dissolved from the soil, and as the solvent action of the acids of the roots is supposed to be imitated by such a citric acid solution, this fact may in no small measure account for the usual healthy growth of cane in the Colony.

Experiments on the Clarification of Cane Juice using the "Stream-Line" Filter.

By C F ARMSTRONG.

The experiments here described on the application of the "Stream-Line" filter to cane juice clarification were carried out in Guatemala this year. This apparatus has been described in this *Journal*,[1] and notices have been given of progress made with it. It is, therefore, unnecessary to give a further account of its construction.

It is now recognized that the real clarification of cane juice is essentially the elimination of colloids, of the identity and nature of which little is known. In the main, all processes rely on the employment of lime to coagulate the colloidal impurities. This is very imperfect, however, except in the carbonatation process, and although the ambition of most sugar manufacturers is to filter all their juice, the industry as a whole has to rely on settling methods with the consequence of a slight cloudiness.

As a large percentage of factories are equipped for ordinary defecation, it would seem that the application of the "Stream-Line" filter can be best effected by using the filter directly after defecation, without waiting for the sediment to settle, thus doing away with large ranges of subsiding tanks and scum presses; and, above all, obviating the holding up of large quantities of hot juices in tanks. With this in view, preparations were made to install the filter in a convenient place and connect to a vacuum line. The first experiment was made as follows:

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[1] *I.S J.*, 1923, 546, 628; 1924, 283; 1925, 162, 333.

Experiments on Clarification of Cane Juice using "Stream-Line" Filter.

The tank was filled with hot, freshly treated juice, containing all the scum formed by the lime and sulphurous acid acting on the juice. A careful record was kept of the flow of filtrate by means of a calibrated test-glass fixed to the receiving tank. The filtrate was brilliantly clear, but no colour change was observed.

The packs, on being removed from the filter, showed a slimy brown scum ⅛ in. thick on their edges, and this was removed by the scraper affixed to the filter. Using compressed air, I found the best method was to cut off the vacuum before the packs emerged from the juice; and as they emerged, and while the scum was wet, and the tubes full of juice, to turn on the air suddenly, without using any scraper. When this was done, the scum fell off immediately, whereupon the compressed air was at once shut off and the packs re-engaged in filtration. The results were almost the same as the original effect with clean new packs, proving that the best method of cleaning is to use compressed air while the pack is full of juice and the scum wet and easily detached. To bear this out, I ran one test by cleaning with compressed air, brushing, and at the same time pouring water on the brush. No better results were obtained, so that we can safely assert that only compressed air need be used. But it must be done as soon as possible after the pack is taken from the juice to be filtered.

After details of the best mode of cleaning the packs were solved, a new series of experiments were started, with the idea of increasing the filtering capacity by employing different compressions of the packs. These experiments were run on lines identical with the first series, using hot defecated unsettled juice, and thoroughly cleaning the filter and tanks with water and compressed air before each test.

I increased the distance between the leaves, and was gratified to find a considerable increase of filtration. Taking a conservative average after cleaning, this was 15·25 galls. of juice per hour per sq. ft. of filtering surface. There was very little filtration after 2 mins.; the same thickness of scum was noticed on the edge of the packs and the cleaning was effected with only compressed air.

If it were possible to utilize each square foot of filtering surface for 1 min. only, each square foot would filter 23·4 galls. per sq. ft. per hour. This, however, I am afraid would be impossible, as in the 1 min. devoted to filtration a certain amount of the time would be handicapped by the change from compressed air to vacuum. The drop takes place at the start after cleaning with compressed air, due no doubt to the time lost in replacing compressed air by vacuum.

As regards the quality of the paper, no deterioration was observed and no loss in weight occurred after weeks of filtering.

From the foregoing, I think it is clear that the filter would be most useful in the early stage, i.e., for the diluted juice from the mills after it is defecated. This however means a very large quantity of liquor to be handled.

We may take it that an average cane factory with modern plant will turn out 200 galls. of juice per ton of cane, which for a factory crushing 1000 tons of cane each 24 hours, equals 200,000 galls. of juice. We know that 1 sq. ft. of surface in this filter will filter 15·25 galls. per hour, but part of the hour is employed in cleaning. I therefore imagine a filter, of which 50 per cent. is filtering and 50 per cent. is being cleaned; then the area of filtering surface required for a 1000-ton factory would be only 1092 sq. ft. This is remarkable, considering that in a carbonatation factory in which the writer worked, where the treated juice is very easily filtered in consequence of the heavy amount of granular precipitate present, the filtering area used (ordinary filter-presses) was 5184 sq. ft. for a crushing capacity of only 450 tons daily.

When it is realized that the filter deals with cane juice defecated in the usual way which hitherto has been almost impossible to filter, I think it will be agreed that an adaptation of the "Stream-Line" filter will greatly benefit the sugar industry. The filtering area required is remarkably small; it would do away with the necessity for keeping large quantities of thin juice lying in tanks, losing sugar and heat, and would thus clear a considerable floor space. Also, the elimination of the noisome scum station present in most factories, and the cutting out of expense of new cloths for the filter-presses (quite a large item in manufacturing costs) would be realized.

There should be a large field for the "Stream-Line" filter in the beet sugar industry. In this branch of the industry, they have the same large amounts of liquor to filter, but the actual filtration is very easy compared with cane sugar factories, as the carbonatation process, which means a granular precipitate, is employed. Without actual work with the filter on beet juices, I hesitate to give an estimate as to the gallons per sq. ft. per hour, but I am convinced that the rate of filtration with the "Stream-Line" filter would astonish most manufacturers.

It may be of interest to mention the filtering capacity of a cane sugar factory in the Argentine, which crushes 1300 tons of cane daily and filters all the juice. The dilute juice is sulphited heavily; lime and a mixture of phosphoric acid and kieselguhr is added, to bring the juice to a slight acidity; the juice is passed through heaters, and then through filter-presses at different pressures. The first is of low gravity; but as the filtration diminishes, a high gravity pressure is used, a pressure of 40 lbs. per sq. in. being finally applied by pumps, and the cake filling the frames being built up gradually. The filtering surface in this particular factory is provided by 40 filter-presses, the total filtering area being 18,000 sq. ft. Of these 40 presses, 15 are actually filtering, the remainder either being cleaned or in readiness. Even with this enormous filtering station, it was hard work to keep ahead of the juice, so it is possible that the "Stream-Line" filter would be of benefit to this factory.

The question may be raised as to the loss of sucrose in the scums. This can readily be dealt with by allowing the scums to fall into a receptacle, then diluting with water and filtering the mixture through another "Stream-Line" filter devoted to this purpose.

The Canadian Sugar Industry.

From a Canadian Correspondent.

The seven sugar refineries in Canada, capitalized at $38,725,000, form an industry which occupies ninth place in importance in the Dominion, although in average value of production per establishment it leads all others. Two of the refineries are in Ontario, the leading Province of the country in manufacturing, two in Quebec, and one each in British Columbia, New Brunswick and Nova Scotia. In addition, the Utah-Idaho Sugar Company of Salt Lake City are building a plant at Raymond, Alberta, with a capacity of 1000 tons of sugar beet a day, and costing about a million dollars. This Company will manufacture all grades of sugar.

These refineries in 1923, the last year for which official figures, just published, are available, produced 420,000 short tons of sugar, valued at $76,144,000. Of this quantity 19,700 tons were made from sugar beet, which was grown that year in Canada to the extent of 22,450 acres, the yield of 216,000 bushels having a value of $1,401,000.

Canadian sugar is reaching the British markets in large quantities this year, and the imports appear to be increasing During the past three years, with the rapidly increasing imports into this country of Continental refined sugars, the imports from both the United States and Canada had been falling off, especially from the former country. In the case of the Dominion, the imports dropped in value from £1,735,000 in 1922, to £966,000 in 1923, to £713,000 in 1924 But during the first five months of this year £709,000 worth was imported, which was just twice as much as in the same period in 1923, and practically the same amount as in the whole of 1924 The imports from the United States during the first five months of 1925 were valued at £432,000, or about 60 per cent of the value imported from the Dominion, as compared with £776,000 in the same period of 1924, and £1,782,000 in 1923 In the five months of this year there has also been a falling off in imports as compared with 1924 from the Netherlands, Belgium and Czecho-Slovakia Imports from Germany during the same period of 1925 increased from almost nothing to about £112,000 Canada, therefore appears to be gaining an increasingly important place in the British sugar market, and if the first five months of this year are an indication of the future, will be an important factor in British supplies of refined sugar Already leading the United States by nearly double the quantity supplied, Canada now occupies third place in supplies to the British market, sending about one-third the quantity furnished by Czecho-Slovakia, and half the amount supplied by the Netherlands.

In 1924 Canada imported about 420,000 short tons of raw sugar, Cuba supplying 85,000 tons, British Guiana and the British West Indies 128,000, San Domingo 78,000, the United States 66,000, Peru 24,000, and the Dutch East Indies 35,000. In addition there was a considerable production of granulated sugar in the Dominion made from Canadian grown beets for which figures are not available, but which could not have been materially different from the figures for 1923, viz , 19,000 tons

The most striking change revealed in the report on the Canadian sugar industry, just issued by the Dominion Bureau of Statistics of the Department of Trade and Commerce, is in the matter of exports of Canadian sugar during April, in which month a total of 12,400 short tons of refined sugar was sent out of the country at a value of $1,666,000, as compared with 4,100 tons valued at $788,000 in April of last year The bulk of the report is given over to statistics of the industry covering the four-week period ending with May 23rd, and the figures run well ahead of last year, not only for the period above-mentioned, but for the period from January 1st to the end of May. Thus for the four-week period total exports stand at 52,800 tons as compared with 33,600 tons in the corresponding period of last year, while total shipments for the period January 1st to May 23rd stand at 200,500 tons, as compared with 147,000 tons in the same period of 1924 Receipts of raw sugar during the four-week period under review were nearly double those for the corresponding period of last year, while total manufacture stood at 53,000 tons as compared with 40,600 tons in the same period of last year. Domestic shipments of refined for the four-week period stood at 31,500 tons, as compared with 25,900 tons a year ago, while export shipments amounted to 21,300 tons, as compared with 7,700 tons in the same period a year ago.

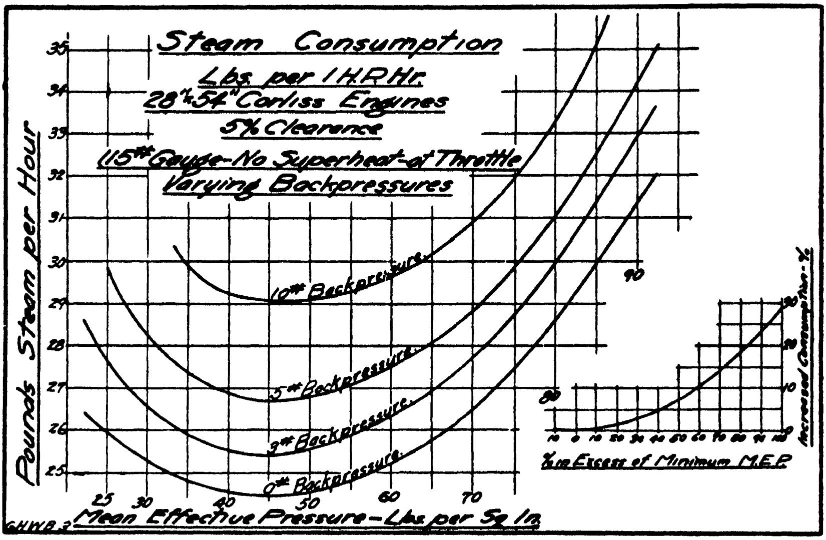
According to *Commerce Reports*, the demand for German machinery by the sugar industry in the Dutch East Indies, amounting to 1892 metric tons in 1913 and 1774 tons in 1922, fell off to only 91 tons in 1923, and ceased entirely in 1924.

Fuel Economy in the Cane Sugar Factory.[1]

By G. H. W. BARNHART

ECONOMICAL SIZE OF MILL ENGINES.

The general rule for power required in an engine driving a 2-roll crusher is 15 i.h.p. per ton of fibre ground per hour; 30 per ton of fibre ground in a 3-roller crusher, and 30 per ton of fibre per hour for each 3-roller mill in a train. This includes power necessary in operating juice strainers and cush-cush elevators, bagasse elevators and other equipment incident to a mill. It is further based on an hydraulic pressure of 75 to 80 tons per lin. ft. of top roller. A slow speed for crusher or mill engines involving a minimum of reduction gearing necessitates a very large engine. A high speed with a large gear ratio is not desired, mainly because of the fact that breakages are likely to occur, and it is desirable to bring the engines to a stop in as short a time as possible. Furthermore, there is a practicable limit to a piston speed. In crusher engines a speed of 75 is the maximum desirable, while for mill engines 60 to 65 has been found to be the practicable limit. A careful study of Corliss engine diagrams and steam consumption data indicates a minimum steam consumption where the mean effective pressure is about 40 per cent. of throttle pressure. Reference to the accompanying diagram will indicate to what extent the steam consumption increases or decreases as the mean effective pressure varies from this figure. For a factory grinding 50 tons of cane per hour with a throttle pressure of 115 and a back pressure of 5 lbs., the difference in consumption could readily be 1400 lbs. per hour equivalent to 2 per cent. of the bagasse. In an extreme case where the pressure is double the optimum, as where an engine operates just short of the point where it would take steam "full stroke," the extra consumption would be equivalent to 9 per cent. of the bagasse.



ELECTRICAL POWER PLANT EQUIPMENT.

The ideal arrangement for a mill power plant where much outside power is supplied is a non-condensing turbo-generator running in parallel with a condensing unit, the former to be controlled by a back-pressure regulator which controls the load on it so that the pressure in the exhaust lines will be maintained at a constant predetermined point. By this arrangement there will be no serious perturbations in the back-pressure system, the quantity of exhaust steam being always equal to the demand by evaporator, pans, and heaters, no live steam being used in these apparatus, the condensing load being maintained at a minimum. The size of non-condensing unit depends entirely on the extent to which the principle of "extra steam" is applied in the factory. The size of condensing unit will depend on this, and in addition the outside load to be carried. A fair estimate of the requirements can be made in each case, but it must be remembered that the demand for exhaust steam varies considerably according to the fluctuations in the boiling house and each unit must be designed for this variation. However, the extreme peak load in the case of the non-condensing unit occurs but a very small part of the time, and can possibly be neglected, as electrical equipment of this type is designed to carry definite overloads for short intervals without harm. The next consideration is the steam rate of the unit. Whereas in central power stations most units are purchased on a basis of full load efficiency and operation is so controlled that only the most efficient machines are delivering power, in the case of a cane sugar factory each of the machines mentioned should be purchased on a basis of average efficiency over the ranges indicated. It will be appreciated at this point that for a given exhaust steam demand, for every kilowatt additional that the non-condensing unit can carry, due to a lower steam rate, the load on the condensing unit is reduced accordingly and a corresponding saving made in bagasse or in the extra fuel bill.

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[1] Paper presented at Third Annual Meeting of Association of Hawaiian Sugar Technologists, Honolulu, October 27th, 1924 (here abridged).

ECONOMIZERS.

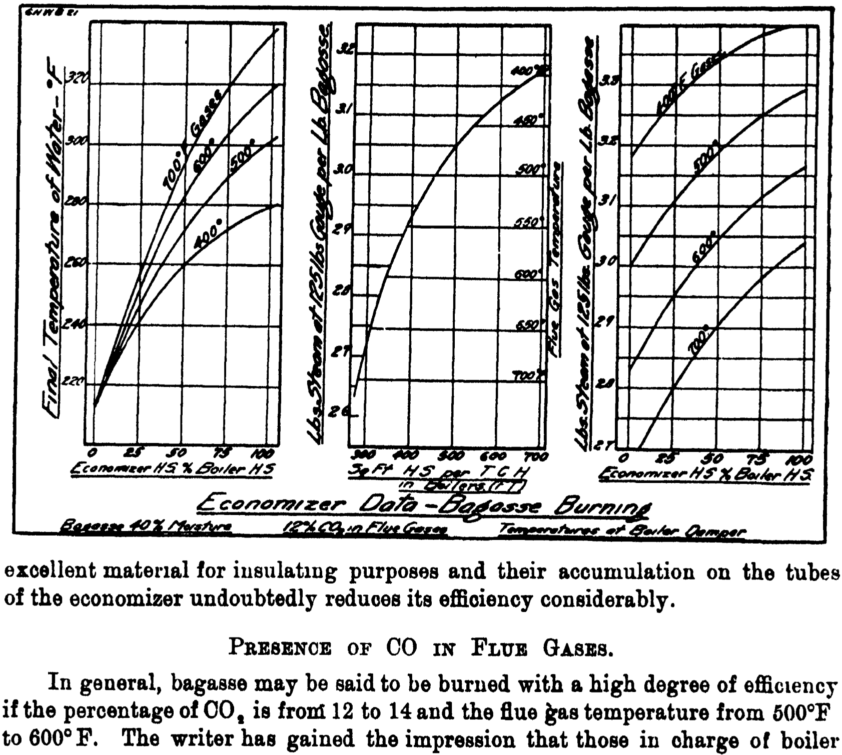
Standard practice indicates a boiler heating surface of 450 sq. ft. of fire-tube boilers for each ton of cane ground per hour, which corresponds to 375 sq. ft. in water-tube boilers. Both take into consideration the heating surface which may be out of commission for cleaning, etc. Assuming that a boiler operates at rating with flue gases at 500° F., then with other conditions favourable the increase in flue gas temperature will increase the mean temperature difference and the rating in proportion. The ratings and other data will then be:—

Temperature of Flue Gases	Sq. Ft. of Heating Surface		Per Cent. of Heating Surface	Boiler Rating Per cent.	Lbs. Steam from 212° F. to Steam at 125 lbs. Gauge
	Fire Tube	Water Tube			
700° F.	283	236	62·9	135·0	2·66
650	312	260	69·2	127·2	2·74
600	353	294	78·5	119·0	2·83
550	395	329	87·8	109·6	2·91
500	450	375	100·0	100·0	3·00
450	530	442	117·9	87·2	3·09
400	676	563	150·1	71·8	3·18

PRESENCE OF CARBON MONOXIDE IN FLUE GASES.

Evidently an increase in rating by raising the flue gas temperature is at a sacrifice in efficiency unless the heat lost can be regained by means of economizers. The diagram on the left indicates the rise in temperature in boiler feed water from an initial temperature of 212° F. with economizer surfaces installed between the boilers and stack; the central graph indicates evaporation per lb. of bagasse for corresponding flue gas temperatures and heating surfaces; while that on the right gives the evaporation per lb. of bagasse with varying combinations of boiler and economizer surface. To obtain, for example, 3 lbs. of steam from 1 lb. of bagasse three combinations are possible, viz.: 450 sq. ft. of heating surface in fire-tube

(375 in water-tube) boilers per ton of cane ground per hour; 353 sq. ft. of fire-tube surface and 131 sq. ft. (37 per cent.) of economizer surface; or 283 sq. ft. of fire-tube surface and 232 sq. ft. (82 per cent.) of economizer surface. Recent prices covering boiler and economizer installations indicate a price of $3·50 per sq. ft. for economizer surface installed and $3·25 per sq. ft. for boiler surface installed. A comparison of these and other combinations indicates that for equal costs an all-boiler installation will invariably show a better economy than a combination of boiler and economizer. This is of particular interest since operation of an economizer under bagasse burning conditions entails difficulties due to the high moisture content of the heated vapours and a continually lowering heat transmission rate due to the accumulation of particles of bagasse carbon in spite of mechanical scrapers. These particles of bagasse carbon have been described as excellent material for insulating purposes and their accumulation on the tubes of the economizer undoubtedly reduces its efficiency considerably.



Economizer Data—Bagasse Burning

Bagasse 40% Moisture 12% CO_2 in Flue Gases Temperatures at Boiler Damper

PRESENCE OF CO IN FLUE GASES.

In general, bagasse may be said to be burned with a high degree of efficiency if the percentage of CO_2 is from 12 to 14 and the flue gas temperature from 500°F to 600°F. The writer has gained the impression that those in charge of boiler room operations are inclined to admit too much excess air to their furnaces in order to prevent the formation of any carbon monoxide. This term has been stressed to the point that it would appear to be the " unpardonable sin " of boiler room operation to have CO detected in one's flue gases. Regarding the extent CO may be tolerated in flue gases, if 12 per cent. CO_2 seems to be the safe upper limit for flue gases without CO, then with gases at 500° F. and moisture per cent. bagasse at 35 the evaporation F/A 212° F. is 3·5 lbs. per lb. of bagasse. Then if the CO does not increase above 0·26, 0·54, 0·73, 0·94, 1·20 or 1·46 per cent. respectively as the CO_2 is increased to 13, 14, 15, 16, 17 or 18 per cent., just as good work is being done in evaporation. Some of the advantages resulting from decreasing the excess air are decreased load on the stack, a hotter furnace, a higher boiler rating, and a lower flue gas temperature.

INSULATION OF HOT PIPING.

Measurements of piping indicate 287 sq. ft. of radiating surface on an average for each ton of cane ground per hour, of which 189 sq. ft., or 66 per cent. may be due to live and exhaust steam piping. Evaporation from bare pipe would be equivalent to 12·64 per cent. of the total bagasse produced, while with 1 in. magnesia covering it would be reduced to 1·61 per cent., and with 1·5 in. covering it would be reduced to 1·46 per cent. The writer has in mind several factories where, on account of insufficient, poor, or no insulation on the return piping, the temperature of condensate is or has been as low as 160° F. In one instance where attention has been given to this detail the average temperature of the return has been increased to 210–212° F., resulting in a saving of slightly over 5 per cent., each 10° rise, roughly equivalent to a 1 per cent. saving. A further saving, not so easily measured, can be accomplished by the insulation of all steam cylinders, traps, hot juice and syrup lines, heaters, pans, evaporators, settling tanks, and other hot surfaces ; and the indirect gain will be a cooler factory and more contented operators. Electrification may reduce the radiation surfaces due to live and exhaust steam piping by fully one-half, while careful consideration of the arrangement and location of the various apparatus should account for a further reduction.

ECONOMY BY "EXTRA STEAM"

The extra use of steam has been discussed frequently as a means of conservation of fuel both in cane and beet factories. In the former the use of double, triple, quadruple and even quintuple effects marks the first step in this process. The use of pre-evaporators supplying vapours for all heating is the second step and will accomplish a 7 per cent. saving in steam in a factory now applying the "extra steam" principle only in so far as it uses a quadruple effect. Further applications of this principle are in common use in beet factories and may effect up to a 31 per cent. saving in steam on quadruple effect evaporation alone. Pressure evaporation probably will not find much, if any, application in cane factories owing to dissimilar conditions. Thermo-compression, while of advantage, in a factory which lacks sufficient heating surface in evaporator or pans, is not an ideal apparatus since it requires live steam in the ratio of about one to one for the pressure. Where there are no outside power requirements this apparatus is of advantage, particularly where live steam is ordinarily used to make up a deficiency in exhaust steam. It is probable also that it would be used only in the final stages of boiling when the total live steam consumption would be slight.

Fuel economy may be effected at the heater station by the use of well insulated, baffled, heaters, while the use of a comparatively high back pressure in the factory will result in a minimum of heating surface with a corresponding reduction in loss by radiation.

Recent developments indicate that the Hawaiian standard of 72 cub. ft of settling capacity per ton of cane ground per hour is insufficient. Juices with less than 0·02 per cent. phosphoric acid do not settle well even with an excess of lime or capacity ; those with 0·03 to 0·04 per cent. phosphoric when limed to phenol alkalinity will settle and leave a limpid juice with somewhat more than 72 cub. ft., while those with more than 0·05 per cent. phosphoric acid require well over 110 cub. ft. This increase in settling capacity naturally increases the radiating surface in tanks. For practical reasons it is advisable to have from 6 to 8 settling tanks at this station.

A large amount of heat is lost at the filter-press station on account of the long cycle involved, an added loss being that due to the prolonged washing which adds to the amount of work at the evaporator station. The Kopke separator is the only means the writer knows of whereby the cycle can be shortened and the quantity of water lessened. This equipment has been given a partial trial during the past season and has demonstrated its possibilities so well that centrifugal separation of settlings will be given a thorough trial on a factory scale during the coming year. A consideration from the standpoint of fuel economy would involve a comparison of power required to drive the centrifugals together with the slight radiation loss, with the extra quantity of wash water to be evaporated together with the large radiation loss and loss by inversion of sucrose in the case of filter-presses.

GENERAL CONSIDERATION ON FUEL ECONOMY.

Four factors, probably, have contributed to the gradual increase in heating surface required in pans, evaporators, and heaters, in the cane sugar factory. These are: (1) an increase in the grinding rate, a natural result of an increase in acreage, of intensified agriculture, of the aim to take off crops which will net the greatest returns to the plantation; (2) an increase in power requirements, due to the introduction of the Messchaert groove, which, eliminating practically all feeding difficulties, has allowed "setting-up" rollers and increasing the hydraulic pressures carried; (3) a decrease in the operating pressure possible in some factories, due to the limitations of lap-seam boilers and to age in other boilers; and (4) the introduction of the calandria type of vacuum pan, permitting faster boiling, and the substitution of exhaust steam in the calandria for live steam in the coils, which has led to increasing the ratio of heating surface to capacity from 1 to 2 to 1·2 to 1 and in some cases 2 to 1. The net result of the first three items has been an increase in the quantity of exhaust steam produced. Back pressures have increased gradually, and where sufficient evaporator surface has permitted, evaporation of syrup to a higher density has been practised. Water added per cent. cane has gradually increased and the evaporation of this has helped to reduce the surplus exhaust. Where he is unable or unwilling to purchase and install boilers for higher operating pressures or to install more economical mill engines, the only remaining expedient of the manufacturer, of increasing the heating surfaces in pans, evaporators, and heaters, and of burning extra fuel when and where necessary, has been resorted to.

This procedure, the writer feels, is an incorrect and uneconomical one. The installation of an additional pan, a heater, and sometimes the substitution of a larger evaporator, should not be made as a means of reducing exhaust pressure, as this will not be accomplished, unless at the same time more liquor from which evaporation can take place is introduced into process. Provided the heating surfaces permit, an actual saving in fuel will be made if the blow-off is set to operate at a lower pressure and the surplus exhaust wasted. The logical procedure in practically all of these difficulties is to replace prime movers which are uneconomical of steam, with apparatus having lower steam rates, or better still to install the more economical apparatus in the first instance, and a surplus of bagasse, indicating that extra fuel is no longer needed, will be the direct result.

The Caroni Sugar Estates (Trinidad) Ltd. report a profit for the year 1924 (the first of this company's trading) of £72,665, or £54,210 net after meeting certain charges, interest, and taxation expenses The 7½ per cent. interest on the cumulative preference shares was paid, and various sums have been transferred to the Reserve Fund, which now stands at £30,000. A balance of £15,678 has been carried forward. The crop of sugar from the Company's estates in the year in question amounted to 8166 tons.

Recent Work in Cane Agriculture.

LIVE STOCK INDUSTRY IN LUZON. *H. F. Hungerford. Compilation of Committee Reports for the Second Annual Convention. Philippine Sugar Association, Manila, October 1st to 7th, 1924.*

The author of this paper considers that, in spite of the increase in motor machinery in the cane fields during recent years, the animal plough is not likely to be superseded in the Philippines for many generations to come. The general trend on big estates is away from administering large areas, and towards subletting to small tenants with 12 to 15 acres, worked by their *carabaos* (water buffaloes) and hand implements.

At the present time a large proportion of these animals is imported as required: which he considers economically wrong in a country where the conditions are ideal for cattle raising. There are in fact herds of native cattle ranging from the north to the south of the Archipelago which thrive perfectly well on the natural pastures. These increase from year to year until an outbreak of disease decimates their numbers. The survivors acquire immunity and breed, but the new members, not having been through an epidemic are susceptible and fall victims; and this cycle continues from generation to generation, the percentage of deaths gradually decreasing with each outbreak. So that ultimately the herds will in time probably acquire immunity such as Indian breeds possess. The greatest losses are at present caused by rinderpest, and vast sums are spent annually by the Government in trying to eradicate this disease. The author would substitute for this policy that of introducing, breeding and distributing immune varieties.

Furthermore, all efforts at cattle breeding are at present concentrated on supplying the meat market. Australian herds, Polled Angus, Herefords, etc., are brought over, all highly susceptible to disease and physically unsuited to tropical conditions. There is no record of any effort to improve the working type of cattle by this means; but it is suggested by the author that all introduction of western types should be given up because they cannot compete with the native breeds. Young work animals are being ruthlessly slaughtered, and Batangas, being the largest stock-producing province in the islands, is being drained of its one to two year olds to fill the car loads sent down weekly to the slaughter houses in Manila. This should be prohibited, as it is quite unnecessary, in that there are many local types useless for agricultural work but quite available for the meat market.

It is pointed out that *cogon* (*Imperata arundinacea*) is the chief component of the natural pasture, and that this has a low food value, being chiefly fibre and water. Large quantities are therefore necessary for the extraction of the small amount of nutriment contained. All of the native breeds have enormous paunches, and the western forms cannot accommodate their systems to assimilate this rough forage; hence they literally starve to death in the midst of what is excellent pasture for the native animals. They rapidly become emaciated and easily succumb to disease.

Turning to the eastern breeds, these are found to vary much in value, although practically all are susceptible of improvement. The commonest type, variously known as the Batangas, Chinese or Hongkong *vaca* is an excellent animal within its limitations: does a good day's work and keeps in first class condition on a minimum of food. But it is short of leg and rotund of body; and these faults, as well as its only slight immunity to rinderpest, may be remedied by crossing it with Indian cattle. The result of this cross is a handsome fawn or bay animal, with leg of medium length and well-formed body; it is highly resistant to the animal diseases of the islands and well able to subsist in the country.

In conclusion, the author summarizes his proposals, and urges that the building-up of herds of working cattle of a resistant type should be undertaken by the Government, as this method is likely to be of greater benefit to the islands than the costly efforts at stamping out rinderpest at present in vogue.

THE CANE BEETLE BORER IN AUSTRALIA (*Rhabdocnemis obscura*). *Agricultural Report, No. 3. R. Veitch, Entomologist, Colonial Sugar Refining Company. December, 1917.*

This report may be taken as an introduction to the following one, dealing with the same pest in Fiji. It treats primarily of the status of the beetle borer in the Australian districts supplying cane for the Colonial Sugar Refining Company's mills; and the situation was so serious at the date of report that a record of the known life history of the pest and its control appeared to be desirable. The author states that, at the time of his inspection, the pest had become destructive in the cane districts of North Queensland, where it threatened to become very formidable, and only secondary to the white grub in importance. The significance of its introduction had not been fully realized, "and little effort had been made to check its ravages in infested districts and to prevent its introduction into new areas. Some of the newest lands were already badly infested, but others were still free from damage, and every endeavour should be made to keep them so." The mills in the south were found to be free. Its distribution in other countries is given, and a short and clear account of its life history, coupled with a useful plate with drawings of the various stages. The nature of the damage and its variations in the different infested fields are discussed, emphasis being laid on the preference of the borer for rank crops on rich land, over light crops on inferior soil.

As preventive and remedial measures VEITCH advocates a campaign for its control, to prevent its establishing itself at mills at present free, and where it occurs to separate the uninfested farms from the infested, and in fields already invaded to reduce the amount of damage. The pest is stated to have been originally introduced in consignments of canes from New Guinea, and its spread in North Queensland is put down to the indiscriminate exchange of seed between the different mills. In view of the possibility of restricting its activities to the north, he recommends that no canes should be sent from this area to the south. For uninfected farms in areas where the beetle is already present he advises the strictest isolation and a careful inspection of all planting material. For the reduction of damage where the pest is met with, the author lays stress on the importance of giving a field a clean start when it is replanted; and he considers burning the trash and rejected cane pieces on the fields as a very effective aid in control. But he does not recommend burning on poor soils, as all the trash is needed for maintaining fertility; and especially because in such fields the canes are not usually seriously attacked. Large numbers of the beetles can be caught in traps of split canes which attract the beetles as soon as fermentation commences. The carrying out of these measures will, it is claimed, greatly reduce the activities of the pest, and the extra expenditure involved will be amply covered by the increased crop obtained. A short addendum is devoted to the moth borer (*Pragmatiphila truncata*), which is a serious pest in places in the southern districts, because of a certain amount of confusion which has been noted between its caterpillar and the grub of the beetle borer; and a figure of this stage of the moth borer is added to the plate for ready distinction.

Recent Work in Cane Agriculture.

THE CANE BEETLE BORER IN FIJI *Agricultural Report, No. 4. October, 1919. Ibid.*

This is the most destructive insect enemy of the cane in the Fiji Islands. It is generally believed to emanate from New Guinea and has been recorded from that island, New Ireland, Fiji, Samoa, Tahiti, Hawaii, and Queensland. It was first known as Calandra, then for many years as Sphenophorus, but has now been referred to Rhabdocnemis. It probably reached Fiji from Hawaii in the early days of sugar cultivation in the islands. It is now firmly established and its eradication is considered impossible. An interesting summary is given of attempts at its control in the past The first serious effort was made in the Rewa district, where in 1891 it was estimated that the loss at Nausori was 18 per cent. of the crop, and in 1892 14 per cent. A vigorous collecting campaign was decided on, which resulted in the destruction of between 2½ and 3 millions of the beetles For the first few years after this campaign the position was so much improved that the collecting ceased Two factors appear to have subsequently militated against the pest In the first place, the destruction of such masses would render its reaching its former numbers only after a certain number of years, and secondly, just at the time when it might be expected again to assume a threatening attitude, a change of varieties of cane took place, which offered it much less favourable breeding conditions The Lahaina cane, a soft recumbent form, much appreciated by the borer, gave place to one called Malabar (Yellow Caledonia), which was hard and fibrous, and presented considerable resistance to attack. But another change was made later on in the introduction of Badila which, step by step, replaced Yellow Caledonia This was more to the liking of the borer weevil and, by 1906, it was considered advisable to commence another collecting campaign After a few years, however, this petered out, partly from lack of enthusiasm on the part of planters and partly because the borer question entered on a new phase, in the recognition of the tachinid fly, *Ceromasia sphenophori* of New Guinea, as parasitic on it Fiji was, in fact, made a half-way station for the living flies on their long journey from New Guinea to Hawaii It was hoped that the introduction of Ceromasia would once and for all settle the borer trouble. But in spite of determined efforts, extending over several years, to add the fly to the beneficial members of the local fauna, the result was a uniform failure This failure was ultimately determined as being due to quite a number of factors more or less peculiar to Fiji In the first place, the fly was found to have serious natural enemies, chief of which were the jumping spiders (Attidae) and a small brown ant (*Pheidole megacephala*), especially the former, which could be seen stalking the flies when they settled on the leaves and leaping upon them with wonderful swiftness and accuracy. The author found that cane fields teemed with these spiders, and from numerous observations formed the conclusion that once a spider started stalking the fly had very little chance of escape The ant materially assisted in the work, attacking the flies immediately after emerging from the pupae, and before they had attained their requisite hardness and full powers of flight. But other less direct factors were seen to be present. One of these is the specially rapid multiplication of the beetle borer on fallen canes, and the liability of the Badila cane to assume this position because of the heavy mass of foliage the flies were noted to find penetration to these crowded places difficult if not impossible. Again, there is a very marked absence of infested canes towards the end of the cutting season, so that although there are plenty of adult beetles about, the food supply of the parasite is cut off, as it only attacks the grub; this interferes somewhat seriously with the carrying on of a continuous life cycle on the part of the parasite. These adverse conditions are absent in Hawaii, and the Ceromasia has there fully justified itself. During the period 1909 to 1917 counts of the canes injured by the borer were made at certain mills. The figures given in average percentages of the numbers of bored canes to the total canes milled were, for Nausori 17·6, Rarawai 5·8, Labasa 18·6, and Lautoka 5·2; but these figures are incomplete, as they take no account of the stalks left on the field as valueless for milling. Of course these are not all bored canes, but most of them are; and as from five to ten tons of such canes are not infrequently thus rejected, some of them riddled from end to end by beetle borer, the damage done is very severe. Such was the position at the time of the publication of this report, and presumably it more or less applies at the present time.

In considering this serious drain on the cane fields, the author remarks that there is a certain level below which losses cannot be reduced, for it is "quite impossible to exterminate the pest." But that minimum has not been reached, and undoubtedly a great reduction of the losses reported is possible. The following indirect methods are suggested: Early ploughing out of fields to be fallowed, early harvesting of badly infested fields, burning the trash after harvesting the plant crops grown on badly infested areas, selection of clean seed and the thorough destruction of all discarded infested seed cane, improvement of drainage wherever defective, and collection of beetles. The paper concludes with a series of paragraphs devoted to a discussion of the reasons for suggesting these remedies. These paragraphs are of considerable interest, but lack of space prevents their inclusion in this article.

SUGAR IN UGANDA. *Mark S. Moody Stuart. Department of Agriculture, Uganda. Circular No. 12, 1924.*

The local Agricultural Department in Uganda appears to have been experimenting with sugar cane for several years past, but has been well advised to secure the services of an experienced West Indian planter to make an examination of the inherent possibilities of the establishment of a sugar industry in the country. The author of the report takes a wide view and he carefully inspected such portions of the country as appeared to be most suitable for the cultivation of the crop. The Uganda Protectorate covers an area of some 110,300 square miles (about the size of Italy), of which over 16,000 are under water. It is situated practically under the Equator, and the lowest parts are between 3000 and 4000 ft. above sea level. It is suggested that this might be considered rather high for sugar cane, but MICHAUD's analyses of cane juices in Costa Rica, at various levels from that of the sea to 6000 ft. above it, are quoted to show that perfectly good juice may be obtained at this elevation. The portions of Uganda most suitable for sugar cane cultivation appear to be clustered around the northern and western sides of the Victoria Nyanza (the recent development in Kenya having taken place on the eastern side, in the Kavirondo country). The rainfall is moderate and extremely well distributed, the only drawback being that there is no cool or dry period for the ripening of the cane at any one time; and the climate and soil are well suited for the growth of the crop. An average of 30 to 35 tons of cane may be readily obtained and, with more care in cultivation, 50 tons should not be difficult. The main interest of the native lies in cotton growing, which extends throughout the region visited and absorbs practically all the local labour. European planters are scattered here and there, and are chiefly concerned with mixed crops of rubber and coffee, although sugar cane is occasionally grown as a subsidiary crop. Their labour supply, and even that of some of the native cotton growers, is largely imported from outlying districts and from Tanganyika, and appears to be sufficiently easy to obtain. Nevertheless, the dominance of coffee and rubber militates against sugar cane receiving the attention which it needs and the cultivation is careless and inefficient. There are a certain number of small concerns owned by Europeans and Indians which produce a raw sugar similar to the gur or jaggery of India, varying as there from a palatable kind of soft brown sugar to an unattractive sticky mass. This product finds a ready sale among the natives. The mills are simple in character, consisting as a rule of three upright rollers, with an extracting power of 67-68 per cent. of the juice; and the boiling is done in open pans, usually single but sometimes in a series; the result is a typical concrete sugar, all the contents of juice forming a solidified mass of crystals. One superior mill has however been built and was just completed as the report was written; in this the crushing is by eight 48 in. rollers and the plant is capable of producing a ton of plantation sugar per hour. The country mills are worked by cattle or by hand labour. But one of the greatest difficulties in the way of the industry is the fact that there are very few cattle because of the prevalence of disease among them. Transport is in fact a limiting factor. All of the cotton is carried as head loads to the buying stations, and thence by motor lorries to the ginneries. Bullock carts are absent, and there appear to be no mules or donkeys: handcarts are occasionally used, but progress by these is painfully slow, while carrying canes on the head is limited to very short distances: motor lorries are not well adapted to carrying canes, and tram lines would not be economical with the small acreages of cane grown. The second great problem is the market. The author remarks that there are millions of people in the neighbourhood who eat very little sugar and many who have never done so; the potential market is thus enormous, but it will take a long time and a considerable amount of effort to exploit it.

As to the future, two main lines of development are open: the foundation of a sugar exporting industry, and an extension of the jaggery business. In considering these, details are given of the cost, equipment, staffs, and prospective markets, for a small muscovado plant (£4000), the smallest direct consumption sugar factory (£12,000), and an up-to-date modern factory (£150,000 and upwards). The author concludes that the immediate future lies in the direction of the smaller concerns, the heavy cost of haulage to coast alone being sufficient to debar companies from erecting large factories. The paper concludes with useful local hints as to the best methods to be adopted by planters in cultivating the cane; simple, common-sense suggestions are made as to distances of planting, drainage, harvesting, ratooning and the purchase of machinery. It is very evident that these subjects are neglected, and any increase in the industry would presuppose improvements along these lines.

ACCION DEL FRIO SOBRE LA GERMINACION DE LAS YEMAS DE LA CAÑA DE AZUCAR. (THE ACTION OF COLD ON SUGAR CANE GERMINATION). *E. M. de Calvino and F. Mastio. La Revista "Chaparra Agricola." Vol. II, Nos. 1 and 2, 1925.*

In the last issue of this journal a short paper was reprinted on the beneficial action of the hot water treatment of cane sets as regards certain insect pests, as well as the stimulating effect on germination; and by a curious coincidence a paper under the above title has since been received on the effect of subjecting them to freezing. This paper is in Spanish, but there is an English translation of the summary of conclusions which are, in the main, as follows.

Placing the sets in water at a temperature as low as 4°C. was less favourable to germination than cooling them in an ice box at freezing point. Cooling in a box surrounded by a refrigerating mixture gave very favourable results both in earliness of sprouting and in the number of buds ultimately germinating. But the results were not altogether consistent with regard to either the time of exposure or the temperature to which they were subjected; so that the curves for these two factors were irregular. In the majority of the experiments the result was favourable, and the following may be taken as the more striking examples. Cooling for 3, 6 and 8 hours at 0° C. gave a benefit, as compared with the controls, of 20, 22 and 18 per cent.; while cooling for two hours at 1·5° C. gave a benefit of 21 per cent. As regards the number of buds germinating, the best results were obtained by a treatment for 8 hours at 3·5 to 8°C. (71 per cent. benefit), and for 3 hours at 6 to 8° C. (benefit 62 per cent.).

C. A. B.

The Pusa Sugar Bureau.[1]

Annual Report for 1923-24 of Mr. Wynne Sayer, B.A.

AGRICULTURAL.

At the close of last year's activities, the Bureau had brought the selected varieties Co 214, 213, and 210 to the stage of large scale distribution. As a result of these activities, all large growers in North Bihar and those in the United Provinces whose estates march with the Bihar White Sugar Tract were provided with these canes. In spite of the monsoon of 1923 proving to all intents a failure in parts of North Bihar, these canes did extremely well and the growers were perfectly satisfied with the results they obtained.[2]

As mentioned in last year's report, the main scheme for growing these three Coimbatore varieties for supply as seed-cane to large cane-growers in the White Sugar Tract was carried through during the year, financed by funds placed at our disposal by the growers concerned. In spite of the fact that Pusa in 1923 suffered from the worst monsoon within memory—24 inches against a normal 45—the crop was excellent. The effect of the short rainfall was, however, distinctly evident in the reduced tonnage due to the canes failing to fill out. (Optimum tonnage will always be linked to optimum rainfall.) The result was that we were short of nearly one-fourth of the quantity we had undertaken to supply. But with some 10,000 maunds of Co 210 and Co 213 made available from Sipaya where these canes were also grown on a large scale by the Deputy Director of Agriculture, Bihar and Orissa, we were able to fulfil our part of the contract, and our thanks are due to that officer for his invaluable assistance in this matter. The short monsoon was followed by a total failure of winter rains, and the canes distributed were of necessity planted in land deficient in moisture. An exceptionally severe hot weather followed and the rains did not break till 20th June. This combination of circumstances has formed the severest test possible, but in the reports now being received all growers are unanimous in stating that these canes have gone through this exceptional test far more successfully than the local cane and a good crop is assured. This means that North Bihar is now established with these three improved canes and their rapid increase in growers' hands is merely a question of time. To sum up—the White Sugar Tract has now got three canes which will completely revolutionize the sugar industry, and the Sugar Bureau is fully justified of the foresight and initiative displayed in its agricultural policy. A policy of complete distribution is now being formulated in which it is hoped the Local Government will participate, as Pusa's small staff, which has so successfully shown the way, can hardly be expected to go further. Both factories and growers are now convinced of the value of the work and willing to afford all the assistance in their power. What is wanted now is a definite policy on the lines of which work can be planned out for a term of years instead of the present hand-to-mouth existence which effectually smothers any detailed programme for the future.

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[1] Abridged from *Scientific Reports of the Agr. Res. Inst.*, Pusa, 1923-24.

[2] See *I.S.J.*, 1924, 642.

These canes have also been sent to Antigua in the West Indies, where they are making splendid progress according to the reports received from those to whom they were supplied. Java and Formosa also asked for Co 210 and Co 213. The careful watch these countries keep on all cane work being done elsewhere speaks volumes for the initiative of the authorities in those countries.

During the year under report, these canes were sent up to the Punjab for trial at Gurdaspur and Lyallpur and also for growing on the British Cotton Growing Association's farm at Khanewal. They have also been supplied to Burma where Messrs. Finlay, Fleming & Co. intend to test them on their sugar cane estate at Sahmaw. We have also sent up Co 213 for trial on the Assam Sugar Estates and Factory at Topolia, District Kamrup, where Co 210 is already showing good results.

As it is desirable to have another early ripening variety to replace Co 214 when it shows signs of deterioration, two early ripening canes, Co 232 and Co 233, were grown on a field scale for mill trial. About 3 acres were put down under Co 232 and 1 acre under Co 233. The crop was grown in a rather sandy field at Birowlie, about two miles away from Pusa, which was rented for the purpose. Co 232, which is a tall, straight-growing cane, grew well, but the deficient rainfall affected the weight of the crop. Co 232 gave 360 maunds of stripped cane per acre, while the yield of Co 233 was a miserable 220 maunds. Both these canes are early ripening as mentioned above, and the short rainfall hastened their maturity. Unfortunately, however, it was not possible to arrange for a mill trial till the 19th of December, when they were put through the Champaran Sugar Factory at Barrah. The following were the results of the mill trial:—

	Sugar per cent on Cane.	Fibre per cent on Cane	ANALYSIS OF FIRST JUICE		ANALYSIS OF MIXED JUICE.		
			Brix.	Purity.	Brix.	Sugar	Purity.
Co 232	12·65	15·55	21·00	77 61	19·20	14·20	73·95
Co 233	10·35	17·13	20·00	69·50	16·00	10·49	65·56

It will be seen from the above analytical figures that even Co 232, which is better than Co 233, is not very desirable from the factory point of view, because of its low purity and its fibre content being higher than that required by the mills.[1]

It is clear that, as the season was abnormal and the cane when supplied to the mills was over-ripe, further tests are necessary. Co 232 has, therefore, been planted again on a field scale to find out its tonnage per acre in a normal year and its behaviour in the mill when crushed at the right time. It has been arranged to have the mill test carried out in November, 1924, along with further mill trials of other canes. Co 233 has not been found satisfactory either in the field or the factory, and for this reason it has definitely been discarded.

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[1] For detailed description, reference should be made to the article on the subject published in the *Agricultural Journal of India*, Vol. XIX, Part IV.

NAME OF SEEDLING.	PARENTAGE.[1]
Co 205	Vellai × *Saccharum spontaneum.*
Co 220	Red Ribbon × Katha.
Co 225	Red Ribbon × Saretha.
Co 227	P. O. J. 213 × Fiji.
Co 228	Karun × M 5459 (A Striped Mauritius rogue).
Co 231	P. O. J. 213 × Kansar.
Co 238	P. O. J. 213 × Fiji.
Co 239	Chittan. General collection.[2]
Co 240	Maur. 90 × M 4600 (Saretha × *Sacch. spon.*).
Co 241	P. O. J. 213 × Katha.
Co 242	Green Mauritius × *Sacch. spon.*
Co 243	A. 2 × Co 206 (An Ashy Mauritius rogue).
Co 244	P. O. J. 213 × Co 205.
Co 245	Vellai × M 1428 (A Naanal rogue).
Co 246	Maur. 1237 × Co 206.
Co 247	Maur. 1237 × Co 206.
Co 248	P. O. J. 213 × M 2 (A Kaludai Boothan rogue).
Co 250	Karun × M 5459.
Co 251	247-B seedling. General collection.
Co 252	P. O. J. 213 × M 2
Co 253	P. O. J. 213 × M 5459.
Co 255	P. O. J. 213 × Co 205.
Co 256	P. O. J. 213 × Co 205.
Co 257	P. O. J. 213 × M 4600.
Co 258	Vellai × Co 206.
Co 259	P. O. J. 100 × Co 206
Co 260	Chittan × Co 206.
Co 261	Chittan × M 10805 (Vellai × *Sacch. spon*).
Co 262	ditto ditto
Co 263	Mauritius 1237 × Co 206.
Co 264	Pundia × Co 205.
Co 265	Green Sport × Co 206.
Co 266	Green Sport × Co 205.
Co 267	Naga B × Co 206.
Co 268	Yellow Bamboo × Co 206.
Co 269	B. 254 × Co 206
Co 270	B. 3747 × Co 206.
Co 271	Black Cheribon × Co 206.
Co 273	P O. J. 213 × Co 222 (Vellai × *Sacch. spon*).
Co 274	ditto ditto
Co 275	ditto ditto
Co 276	ditto ditto
Co 277	ditto ditto
Co 278	P. O. J. 213 × Maur. 55.
Co 279	P. O. J. 213 × Maur. 131.
Co 280	P. O. J. 213 × Purple Mauritius.

It has been mentioned in the previous year's report that the ratooning qualities of the approved canes Co 210, 213 and 214 are being tested at Pusa. The results so far have shown that Co 210 is a good ratooner, Co 214 coming next to it, while Co 213 stands last when there is short rainfall. When, however, the monsoon is favourable, Co 213 improves its position as it is a cane which readily responds to water and manure. From the reports received from growers who have ratooned these canes, it appears that they are satisfied with the superior ratooning qualities of these seedlings over those of the local Hemja or Bhurli, and it now looks pretty certain that among large growers the local variety will soon be replaced by the improved canes distributed from Pusa.

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[1] In giving the parentage of crossed seedlings the mother is always put first and the father second, Vellai × *Sacch. spon* means "Vellai" is the mother and "Sacch. Spontaneum" the father.

[2] General collection means that the seeds were collected from unbagged flowers, i.e., without any definite attempt at controlling the male parentage

Besides this, in the experimental plot at Pusa several new seedling canes are being tested During the year under report 46 seedling canes were under observation (see opposite page)

Out of these seedlings the following have been selected for further experiment —Co 205, 248, 250, 255, 260, 270, 273, 275, 278 and 280 Co 205 has done very well so far It is not a cane that the growers in the White Sugar Tract are likely to grow on high land, but as it has the reputation of withstanding drought as well as water-logging, it can well be used for waste lands and *jheels* This cane is now being supplied to Birowlie, Bowariah and Gangoulie with a view to test how it does under the conditions mentioned above when met with in the district

Co 248* appears vigorous and fair in tillering Its sucrose in juice is 17 8, purity 88 8, cane similar to Co 213 type

Co 250 is a lighter coloured cane with fair vigour Sucrose in juice 18 58 purity 90 9

Co 255 Fair vigour, satisfactory tillering Sucrose in juice 19 30, purity 96 5

Co 260 Fair vigour, cane of Co 210 type in thickness Sucrose 17 09 purity 88 1

Co 270 A light coloured cane, apparently a strong grower Sucrose 18 72 purity 90 72

Co 273 A strong grower with satisfactory habit, canes perhaps slightly thinner than Co 213 Sucrose 18 00, purity 91 3

Co 275 Satisfactory in the matter of vigour, stand and habit, three points of considerable importance in a field crop, good tillering, perhaps a little thinner than desirable Sucrose in juice 16 14, purity 89 8

Co 278 Satisfactory in stand, vigour and habit, canes similar to Co 213 Sucrose 18 72, purity 91 9

Co 280 Satisfactory in vigour, stand and habit, fair tillering, a light coloured cane Sucrose 17 89, purity 89 8

Six further seedlings, embracing a departure from the ordinary which it is calculated will prove well suited to the White Sugar Tract, are now on trial by the Bureau. But it is too early to report other than to say that we consider that one at least heralds a further revolution if its present promise is maintained The Bureau in its cane testing work on the agricultural side has now established a definite routine which enables us to gauge the agricultural possibilities of a cane in a much shorter period than formerly, while we are now in possession of data regarding the essential factors required to meet the agricultural and climatic conditions in the tract which will do away with a great deal of the preliminary testing and investigation which was required formerly One has, therefore, every hope that in future improved canes will find their way to growers in a much shorter period

During the year under report, manurial experiments were carried out with different nitrogenous manures, oil-cake, nitrate of soda and ammonium sulphate but as the season was abnormal the results were inconclusive At the suggestion of the Secretary, Sugar Bureau, the use of sulphate of ammonia which is now available in quantities from the coalfields of Bengal and Bihar at a favourable price, having regard to the percentage of nitrogen contained in it, is now being taken up by large growers. Nitrate of soda seems to be particularly useful as a quick-acting fertilizer for forcing the growth of the cane crop.

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* These canes were crushed in a 3 roller bullock driven mill and analysed in the first half of January, 1921

The Secretary, Sugar Bureau, devised a 3-row ridger working behind a tractor to meet the requirements of growers of cane who are faced with the planting of a large acreage at the optimum time, and sent up the plan to Messrs. Ransomes, Sims & Jefferies, to work up. These ridgers have arrived, have been tested and found to do excellent work, the one difficuity being that of organizing the labour to keep pace with the ridger. The planting outfit recommended by the Secretary, Sugar Bureau, consisting of a double mould board plough, subsoiler and gatherer and roller, is being widely taken up in the White Sugar Tract, and the growers are now keenly alive to the improved implements put out by the Bureau.

As a testimony to the way in which the factories in the White Sugar Tract value the work now being done by the Bureau, the Indian Sugar Producers' Association, of which these factories are members, has granted a sum of Rs. 15,000 to the Secretary, Sugar Bureau, to enable him to continue the sugar cane experiments till the proposed sugar cess becomes an actuality. The Government of India have also placed at the disposal of the Indian Sugar Producers' Association free of charge for a period of one year in the first instance a farm of about 143 acres called the New Area at Pusa, and it is hoped that the nucleus of a fully equipped cane experiment station for the White Sugar Tract will be built up on this foundation. It is on this land that Co 232, 213 and 210 have been planted for the mill trials to be carried out in November, 1924.

CONCLUSION.

The work done by the Bureau in the testing of improved varieties of cane and their distribution to growers has so impressed the sugar factories in the White Sugar Tract that a move is now on foot to bring the question of the white sugar cess before the legislature for consideration and final adoption. The root cause of the stagnation of the sugar industry in India has been in the past the inadequate supply of raw material, and this is bound to continue so long as the inferior local canes are grown. The introduction of exotic canes will do no lasting good, and India must fall into line with other countries in the matter of raising her own superior cane seedlings by crossing where necessary, testing them both in the field and the factory and then distributing only the approved ones to the growers. This work is at present being done by the Coimbatore Cane Breeding Station and the Sugar Bureau, and as it is of such immense importance to the industry it should be placed on a sound and permanent footing.

As usual, I have to express my acknowledgments to a large number of officers and others who have helped me in my work either financially or by giving advice or other facilities that I required. Where so many have helped, it would be invidious to mention names, but I have particularly to thank the firm of Messrs. Begg, Sutherland & Co., who have always readily placed funds at my disposal for mill trials of selected seedlings, Mr. **Noel Deerr** for valuable advice on numerous technical points, Rao Saheb T. S. **Venkatraman**, the Government Sugar Cane Expert, for the most willing assistance he has been giving me, and the Indian Sugar Producers' Association for providing the finance to carry on research work on cane during the year 1924-25. I think that what has been achieved has justified both advice and expenditure, and it is merely a question of more funds for the Bureau to advance further into the field.

Review of Current Technical Literature.[1]

INADEQUACY OF THE METHYLENE BLUE METHOD FOR THE DETERMINATION OF THE DECOLORIZING POWER OF CHARS AND CARBONS *Frz Kercher. Vereins-Zeitschrift, 1925, 245-259*

Methylene blue has so long been used as a medium for decolorization in the evaluation of bone chars and carbons, that it seemed of interest to ascertain how its results compare with those obtained when a sugar product, such as molasses, is used An 0 02 normal solution of this dye (i e , one containing 4 06 grms per litre) was employed, 25 c c being heated with say 2 grms of the sample at 20° C , or higher temperature, for about 30 minutes, and the excess of blue titrated with standard titanous chloride, as directed by KNECHT and HIBBERT [2] Preliminarily various conditions as to time, temperature, ratio of carbon and blue were studied, but the only point of interest in these experiments appears to be that on the action of electrolytes, when it was noted that sodium carbonate increased the decolorization by about 20 per cent , that sodium chloride and sodium acetate had a similar though less pronounced effect , but that calcium hydroxide decreased it to a marked degree Following this, comparative tests by the two methods were made using on the one hand an 0 02 normal solution of methylene blue, and on the other a 2 0 per cent solution of beet molasses, and heating to 80° C during 15 minutes, the percentage of colour removed being found in the first place volumetrically as indicated and in the second by means of the colorimeter In each case three series of determinations were made, the degree of decolorization realized in each being 30, 40 and 50 per cent , and the number of carbons examined being eight Here are the results obtained from which it will be seen that the figures for the same carbon by the two methods differ considerably from one another —

Decolorization realized per cent	A	B	C	D	L	F	G	H
				METHYLENE BLUE				
30	1 43	0 42	1	12 90	2 10	2 02	1	2 83
40	1 48	0 46	1	14 52	2 08	2 09	1	2 83
50	1 51	—	1	14 60	2 06	1 94	1	2 81
				MOLASSES				
30	0 80	0 43	1	7 33	0 78	2 24	1	0 30
40	0 89	—	1	7 13	0 78	2 39	1	0 35
50	0 91	—	1	7 16	0 77	2 56	1	0 38

Thus the percentage of decolorization in the case of carbon ' H'' is 2 8 with methylene blue but only 0 3 with molasses, whilst with other carbons the differences are hardly less striking This result is not to be wondered at, since the adsorbendum in the first method is a uniform crystalline substance and in the second is a mixture of colouring matters together with other non-sugar bodies including alkali salts, which are known to inhibit adsorption It is therefore concluded that the methylene blue process is quite inadequate for the examination of carbons intended for use in the sugar industry Had its results approached fairly closely to those obtained with molasses, raw sugar liquor, juice, or other sugar factory or refinery product, it would have proved a most convenient circumstance, since the analytical procedure involved is both rapid and exact

STANDARD METHODS FOR THE DETERMINATION OF SUCROSE (IN THE ABSENCE OF RAFFINOSE), USING HYDROCHLORIC ACID AND INVERTASE AS HYDROLYST *F. W. Zerban. Journal of the Association of Agricultural Chemists, 1925, 8, No. 4, 400-401*

As Associate Referee on Polariscopic Methods, Dr ZERBAN recommends that the directions given in the " Book of Methods " for the determination of sucrose with hydrochloric acid (in the absence of raffinose) be amended to read as follows --Dissolve the double normal weight (52 grms) of the substance in water in a 200 c c flask , add basic lead acetate carefully, avoiding any excess, then 1-2 c c of alumina cream , shake , dilute to the mark with water , mix well , and filter, rejecting the first 25 c c at least of the filtrate Cover the funnel with a watch glass , remove the lead from the solution by adding dry powdered potassium oxalate ; mix ; and filter again, rejecting the first 25 c.c. at least of the filtrate. Pipette one 50 c.c. portion of the lead-free filtrate into a 100 c.c. flask ; dilute with water to the mark ; mix well, and polarize in a 200 mm. tube. The result, multiplied by 2, is the direct reading (P of formula given below) or polarization before inversion. For the invert reading, pipette to another 50 c.c. portion of the lead-free filtrate into a 100 c.c. flask, add 25 c.c of water : then, little by little, while rotating the flask, 5 c.c of hydrochloric acid of sp. gr. 1·1918 at 20°/4°C., or 10 c.c. of the acid of sp. gr. 1·1029 at 20°/4°C. Heat a water bath to 70°C. ; regulate the burner so that the temperature of the bath remains approximately at that point ; place the flask in the water bath, insert a thermometer, and heat with constant agitation until the thermometer in the flask indicates 67°C. This preliminary heating period should require from 2½–2¾ mins From the moment the thermometer in the flask indicates 67°C., leave the flask in the bath for exactly 5 mins. longer, during which time the temperature should gradually rise to about 69·5°C Plunge the flask at once into water at 20°C. ; when the contents have cooled to about 35°C , remove the thermometer from the flask, rinse it, and fill almost to the mark Leave the flask in the bath at 20°C. for at least 30 mins longer, and finally make up exactly to volume. Mix well and polarize the solution in a 200 mm. tube provided with a lateral branch and a water-jacket, maintaining a temperature of 20°C This reading must also be multiplied by 2 to obtain the invert reading. If it is necessary to work at a temperature other than 20°C , which is permissible within narrow limits, the volumes must be completed and both direct and invert polarizations must be made at exactly the same temperature.

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[2] Berichte 05, 3318

Calculate sucrose by the following formula : $S = \dfrac{100\,(P - I)}{143 + 0{\cdot}0676\,(m - 13) - T/2}$, in which S = percentage of sucrose ; P = direct reading, normal solution ; I = invert reading, normal solution ; T = temperature at which readings are made , and m = grms. of total solids in 100 c.c. of the invert solution read in the polariscope.

Regarding the directions already given for inversion with invertase, it is advised that these read as follows :—To another 50 c.c. portion of the lead-free filtrate in a 100 c.c. volumetric flask add glacial acetic acid, drop by drop, until the reaction is acid to litmus ; add 10 c.c. of the invertase solution ; fill the flask with water nearly to 100 c.c. ; let stand in a warm place (about 40°C) overnight ; cool, and make up to 100 c.c. at 20°C. Mix well and polarize at 20°C. in a 200 mm. tube. Allow the solution to remain in the tube for an hour and repeat the polarization. If there is no change from the previous reading, the inversion is complete, whereupon the reading and temperature of the solution are carefully noted. Correct the polarization for the optical activity of the invertase solution and multiply by 2. Calculate the percentage of sucrose by the same formula as stated above, but using the factor 142 in place of 143.

REPORT ON CHEMICAL METHODS FOR DETERMINING REDUCING SUGARS. *R. F. Jackson.* *Journal of the Association of Official Agricultural Chemists, 1925, 8,* No. 4, *402-404.*

As the result of Dr. Jackson's survey (at the Fortieth Annual Convention of the A.O.A.C.), he advises that suggested activities may be classified under three heads : (1) Incorporation of the results of recent research ; (2) discarding duplicate or obsolete methods ; and (3) examination of the limits of accuracy of present methods. It is recommended that the following subjects be studied (which obviously will require many years to complete) :—(1) The volumetric method of **EYNON** and **LANE**[1] in which methylene blue is employed as an inside indicator : (2) the volumetric method in which the reduced copper or residual unreduced copper is determined iodimetrically[2] ; (3) the method of **QUISUMBING** and **THOMAS**[3] or an equivalent method of high precision ; (4) a micro-chemical method ; (5) the iodine method for aldose sugars[4] ; (6) the electrolytic method for copper ; (7) the reduction of copper in alcohol vapour ; (8) a selective comparison of the methods now given in the "Book of Methods" ; (9) the limits of accuracy of the respective methods ; and (10) a verification of the standard reference tables

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[1] *I.S.J.*, 1923, 143, 305 ; 1924, 107 ; 1925, 332. [2] *I.S.J.*, 1922, 272 ; 1923, 489.
[3] *I.S.J.*, 1922, 102. [4] *I.S.J.*, 1921, 50.

Review of Current Technical Literature.

PREVENTION OF INVERSION IN THE SULPHURING OF RAW JUICE. *E. Haddon.*[1] *Communication to this Journal, April, 1925.*

In 1904 BONNIN and the author[2] pointed out that the glucose ratio of sulphured juice was always higher than that of the unsulphured, and that there was no doubt about an inversion, which should be taken into account when reckoning the amount of sugar entering the factory. LONGCHAMP PITOT in 1915[3] gave the following figures.—Glucose ratio of the sulphured juice, 7·3; and of the unsulphured, 6 6, which figures of course vary with the temperature of the juice, the amount of sulphured acid present, and the purity of the juice itself. Having continually given his attention to the sulphuring apparatus, however, the author now obtains the same glucose ratio for the two juices. In factories where the juices are first limed and then sulphured, the glucose ratios of the two juices remain the same, this being due to the neutralization of the sulphuric acid which is gradually being found by the oxidation of the sulphurous acid. Dr. L. NOWAKOWSKI in 1904[4] showed that no inverting action of SO^2 in pure sugar solutions previously limed can be detected, whilst the author on studying the influence of SO^2 on slightly limed cane juices has found that even at 50°C. 1 per cent. of free SO^2 has no inverting action. In order, therefore, to prevent inversion in the factory, it is necessary only to add some lime now and then to the sulphuring tank. This might be done at each emptying of the measuring tanks, but destruction of sugar by heat always takes place when steam ejectors are used for drawing in air for the combustion of the sulphur, and for forcing the acid into the juice It is found that the top part of the coil which is not immersed in the juice, is very quickly covered with a coat of carbon, having sometimes a thickness of 2 inches. The only way to prevent this destruction is to isolate the top part of the lead coil by mean of a larger cylinder of lead, closed and soldered at the bottom to the coil.

DECOLORIZING CARBONS IN INDUSTRY. *Bernard N Glick.* *Drug and Chemical Markets* (New York); through *The Chemical Trade Journal, 1925, 76, No. 1985, 693-694.*

Writing on the application of active carbons in our industry, the writer (who is Research Director to the Industrial and Chemical Company, New York), states that:— "The displacement of the old bonechar method of refining from the sugar industry has been rendered very difficult because economic factors in the past have forced this industry into the hands of large interests who have invested tremendous sums of money in the equipment incidental to this method of refining. When the production of white sugar was first developed, the only known method of refining was the bonechar method described above. The economic exploitation of this process made large plants necessary, together with an unlimited source of pure water and cheap fuel. These demands rendered it impossible to refine sugar in the tropics and led to the establishment of the two-stage system now in use for the production of standard granulated sugar, a system which in view of the new methods now possible, has no economic justification. The use of these powdered vegetable carbons and the small capital outlay involved in the equipment required for their use, together with the absence of any undue demand for water and fuel, has rendered it possible for any raw sugar producer, no matter where situated, to add a refinery which enables him to make white sugar directly on the plantation at a price much below that possible by bonechar methods. Not only that, but he can then produce a staple product which has a universal sale and will keep indefinitely, as against raw sugar which must be marketed as soon after manufacture as possible." In addition to sugar and oils, some materials in the manufacture of which carbons are being advantageously applied are the following:—Tartaric and citric acids; acetamide, various alkaloids; numerous pharmaceutical and photographic preparations; alcoholic liquors for the removal of colours, thus obviating re-distillation; laundry solvents, for the same purpose; phosphoric acid; vinegar; fruit juices; pectin; lactic acid; sugar used for preparing candied peel, etc.

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[1] Chemist, Labourdonnais, Mauritius

[2] *Bulletin Association des Chimistes de France*, 1904

[3] *Bulletin Société des Chimistes de Maurice*, 1915

[4] *Bulletin Association des Chimistes de France*, 1904.

THE ABSORPTION SPECTRUM OF RAW CANE SUGAR AS AFFECTED BY HYDROGEN-ION CONCENTRATION. F. W. Zerban. *Paper presented before the Sugar Division, American Chemical Society, at Baltimore, Md, April, 1925.*

A 55° Brix solution of a Cuban raw sugar was defecated with lime and phosphoric acid, and the resulting liquor treated with varying quantities of boneblack, under conditions approximating those in the refinery. In every case the filtrates were carefully prepared for spectro-photometric analysis, and the specific absorptive index determined at every 10 $\mu\mu$ between $\lambda = 440$ to 500, and every 20 $\mu\mu$ between $\lambda = 500$ and 700. It was found that defecation as well as boneblack treatment produces a change not only in the -log t values throughout the spectrum, but also in the Q-ratios. In every case the Q-ratios on the basis of -log t at $\lambda = 560$ were found to be larger at the blue end of the spectrum, and smaller at the red end, than they were for the raw sugar itself.[1] When the same raw sugar was affined by thorough washing with a saturated white sugar syrup, the Q-ratios at the red end became larger, and those at the blue end smaller. The change in the Q-ratios caused by defecation and by boneblack treatment may be due principally to three factors, namely, change in hydrogen-ion concentration, change in temperature, and selective adsorption, or a combination of them. In a study of the first of these factors, hydrogen-ion concentration, at room temperature, it has been found that the change in pH brought about by addition of sodium hydroxide causes an appreciable increase in the -log t values throughout the spectrum. But within the range of pH encountered in refinery operations this increase is equivalent to an increase in concentration of the same colouring matter, the Q-ratios not changing appreciably. When the pH value goes above 7 5, there appears to be a slight change in the Q-ratios also, but this point needs further study, by making determinations over a wider range of pH values than has been done so far, which has been between 5·3 and 8·3. If the hydrogen-ion concentration is changed by the use of lime-water instead of sodium hydroxide solution, increased -log t values are also noted, but at equal pH the lime-treated solution is lighter than the soda-treated. Thus there appears a distinct tendency towards decolorization. There is also noted in the case of the lime-treated solutions a more distinct change in the Q-ratios, which is probably due to the formation of a precipitate of calcium salts causing adsorption of colouring matter. The slight change in Q-ratios observed when sodium hydroxide is used in larger quantity may be due to a similar cause.

DETERMINATION OF REDUCING SUGARS, GRAVIMETRICALLY AND VOLUMETRICALLY (WITH ELIMINATION OF TWO SOURCES OF ERROR). Leo Pick. *Zeitschrift fur die Zuckerindustrie der Czechoslovakia, 1925, 49, 211-216, 219-225, 235-241, 243-250.*

Most chemists when operating the gravimetric method of determining reducing sugars must have experienced difficulty in obtaining repeat results under conditions that appear to be the same. Thus in parallel determinations under conditions seemingly identical, differences up to 10 mgrms. of copper (Cu) may occur BAUMANN,[2] BEYERSDORFER,[3] BRUHNS[4] and the author, believe the varying factor to be the rise and fall of the temperature during boiling, "superheating" occurring to a greater or less extent during the irregular boiling of the alkaline solution, the cupric reduction varying accordingly. With the object of maintaining a more even ebullition the author has tried the value of adding different substances to the assay liquid, observing the temperature meantime. None of the substances under examination, however, was entirely satisfactory, (e.g., wood charcoal, talc, decolorizing carbon, pumice, kieselguhr, etc.), but wood charcoal, extracted with nitric acid and washed with water, dried and ignited, was selected as the most suitable for the gravimetric method, i.e., Herzfeld's procedure, the CuO and charcoal being collected in a Gooch crucible, which was heated in an electric oven to burn off the carbon, the copper oxide being reduced to the metallic state by

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[1] For the nomenclature used here, see PETER and PHELPS. *Sugar*, 1925 (May), 223-224.

[2] *D Z.*, 1890, 778. [3] *Centr. Zuckerind.*, 1921-22, 30, 1473. [4] *D. Z.*, 1919, 403, 438.

Stanek's procedure, using alcohol Talc was employed for the volumetric method, following Schoorl and Regenbogen's modification,[1] in which the cuprous oxide is dissolved in neutral ferrous ammonium sulphate solution, the liquid acidified, and the resulting reduction ascertained by titration with standard permanganate Figures are cited to show that when the powders named are added to the boiling liquid the results obtained are much more regular, and lower, the difference between parallel determinations being thus lowered to about one-tenth of that observed in the ordinary procedure without any such addition Another source of error is also here discussed On comparing the results obtained by the gravimetric and volumetric methods just mentioned, the results averaged about 3 mgrms higher with the former than with the latter process This difference was proved to be due to the presence of insoluble matter in the Fehling's solution used in the gravimetric method, so that when the white liquor (containing 173 grms of Rochelle salts and 50 grms of sodium hydroxide in 500 c c) was previously filtered it disappeared Another point commented upon in this useful study is that in determining the "reducing sugars" in some sugar factory products, a reduction lower than that corresponding to the sucrose present (working in pure solution) may sometimes be obtained This result is believed to be due to the presence in the product of some body (probably colloidal, not removed by the usual clarification), which holds the cuprous oxide in solution One may observe, lastly, that this paper presents a very complete review of the history of the determination of reducing sugars by different methods

The Mercury Arc and Wave Length 560 $\mu\mu$ in the Spectrophotometric Analysis of Technical Sugar Products *H H Peters and F P Phelps Paper presented at Meeting of Sugar Division, American Chemical Society, Baltimore Meeting, April, 1925*

The mercury arc gives out several monochromatic rays, $\lambda = 576\ 9\ \mu\mu$ and $\lambda = 579\ 2\ \mu\mu$ (average 578 $\mu\mu$) in the yellow, $\lambda = 546\ \mu\mu$ in the green, and $\lambda = 436\ \mu\mu$ in the blue This type of discontinuous spectrum is well adapted to the analysis of technical sugar products and has already been used in this connexion by F J Bates[2] and associates in 1919 (paper entitled "Analyses of Refined Sugars," presented before the Sugar Division of the Chicago Meeting of the American Chemical Society, September 1920) Since that date the wave length $\lambda = 560\ \mu\mu$ has acquired special significance, as it has been found that the specific adsorptive index, $-\log t$ at this wave length ($\lambda = 560\ \mu\mu$) may be converted into a correct colorimetric equivalent measure expressed as n colour degrees or n units of colouring matter per 1 grm of saccharine dry substance The $-\log t$ at $\lambda = 560\ \mu\mu$ may be calculated from the observed $-\log t$ at $\lambda = 578\ \mu\mu$ and at $\lambda = 546\ \mu\mu$ by a very simple procedure It is shown by complete spectrophotometric determinations of absorption that this calculation can be made with sufficient accuracy by subtracting from $-\log t$ at $\lambda = 546\ \mu\mu$, 48 per cent of the difference between the $-\log t$ at $\lambda = 546\ \mu\mu$ and the $-\log t$ at $\lambda = 578\ \mu\mu$ The $-\log t$ at $\lambda = 560\ \mu\mu$, divided by 0 00485, is the desired converted measure mentioned above, i e , n units of colouring matter in 1 grm of saccharine dry substance Without such conversion little more advantage would be gained by the knowledge of $-\log t$ at $\lambda = 560\ \mu\mu$ than at some other wave length, $\lambda = 546\ \mu\mu$, for instance The $-\log t$ at $\lambda = 560\ \mu\mu$ must be known if a correct colour grading is to be made from absorption or transmission measurements The above interpolation is useful when lower-priced photometers are utilized in place of the more expensive spectrophotometers

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Multiple Effect Distillation of Ethyl Alcohol *George Calingaert. Chemical and Metallurgical Engineering, 1925, 32, No 9, 362-363* —Under the best conditions, the present method of distilling alcohol requires 35 lbs. of steam per gallon of product, the cost of the steam (at 60 cents per 1000 lbs) being 2 cents per gallon, or about 10 per cent. of the total cost of the spirit, though in many plants it may be as much as 25 per cent. Accordingly, opportunity for steam economy is afforded by the use of multiple effect distillation, and the author advocates a triple or quadruple apparatus, separated by dephlegmators and terminated by a final condenser. Mechanism of Lime Burning. *G. Keppeler. Zeitsch. fur angew. Chem., 1925, 38, 309.*—The dissociation pressure of $CaCO_3$ is scarcely perceptible at 600°C.; it increases till it reaches one atmosphere at 900°C. At this temperature the decomposition depends only on the flow of heat to the limestone In practice the controlling factors are the dissociation pressure and the rate of penetration of heat into the limestone. Reducing agents (coal or hydrogen) are favourable to the reaction. Device for counting Bags of Sugar, etc. *Anon. Chemical and Metallurgical Engineering, 1925, 32, 391.*—An account is given of the electrical method of registering the number of bags entering and leaving the plant of the Californian and Hawaiian Sugar Refining Corporation. The ease of control is a point in favour of this system, as compared with the use of a mechanical device, which can be made to register only at or near the place of operation. In a plant of the size of the one at Crockett it is necessary to place such registering units at long distances apart. Cane Juice pH Measurement. *H. A. Cook. Sugar, 1925, 27, 211-212, 264-265* — Measurement of the hydrogen-ion concentration of cane juices electrolytically is an operation calling for many precautions, and here are set forth the conditions necessary for securing accurate results in such operations. Colour Nomenclature in the Sugar Industry *H. H. Peters and F. P. Phelps. Sugar, 1925, 27, 223-224* —U.S. Bureau of Standards chemists have adopted for the study of colour in sugar products the recommendations contained in the various reports of the Optical Society of America on Standards and Nomenclature, and the new terms and symbols are here stated. Explosion of Sugar Dust. *L. J. Trostel and H. W. Frevert. Sugar, 1925, 27, 119-121.*—This is an examination of the recent work by Beyersdorfer[1] and others, which is considered "well supported by experimental data." Method for the Manufacture of Levulose. *R. F. Jackson, C. G. Silsbee, and M. J. Profitt Sugar, 1925, 27, 9-11.*—"Existing sugar factories should be readily adaptable with the aid of a reasonable amount of new machinery to the manufacture of levulose, and we see no reason why ordinary sugar could not be produced during the regular season, and levulose immediately thereafter. Levulose has so long been considered uncrystallizable, that it is difficult for the sugar world to realize that an article superior to sucrose is economically possible."

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[1] *D Z*, 1917, 563

[2] *I S J*, 1920, 654

Some Possible Developments in the Sugar Industry. *Anon. Chemistry and Industry, 1925, 44, No. 4, 71-72.* — Lecture Apparatus to Demonstrate Multiple Effect Evaporators. *F. Giordani. Annali Chim. Appl, 1924, 14, 310-313* —The Manufacture of Saccharin at Nottingham. *Anon. The Industrial Chemist, 1925, 1, No. 1, 5-9.*— The Power Alcohol Problem. *Herbert Langwell. Ibid., 1925, 1, No. 1, 14-16.*—Hydrated Lime as a Chemical Base (Lime Slaking Machines). *Alfred B. Searle. Ibid., 1925, 1, No. 1, 38-41* —Vegetable Adhesives (e g, those made from Exhausted Beet Slices) *T. W. Jones Ibid, 1925, 1, No. 1, 43-45.*—Indanthrene Blues: Notes on their Manufacture *Raffaele Sansone. The Chemical Trade Journal, 1925, 76, No. 1971. 261-263.*—Studies on the Suction Leaf Filter. *B. W. Clarke, S. G. M Ure, and J. W. Hinchley. The Chemical Trade Journal, 1925, 76, No. 1967, 131-132.*—The Motor Spirit Position. *Harold Moore*; through *The Chemical Trade Journal, 1925, 76, No. 1976, 135-136.*—Steam Generation under Critical Conditions. *David Brownlie. Chemistry and Industry. 1925, 44, No. 9, 123-129.*—Production of Coarse Grained Crystals. *Hugh Griffiths. The Chemical Trade Journal, 1925, 76, No. 1965, 67-68.*

J. P. O.

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[1] *I.S.J*, 1922, 573 ; 1923, 412, 551.

Review of Recent Patents.[1]

UNITED KINGDOM.

Production of Active (Decolorizing) Carbon. *S. G. S. Dicker*, of 20, Holborn, London *(G. W. Wallace*, of San Francisco, Cal, U.S.A.). *234,161.* · January 25th, 1924.

Activated carbons or carboniferous products for decolorizing, etc., are produced from carbonaceous materials by a closed chamber process involving internal combustion as the carbonizing means. Heat is supplied from the top of the charge and downward carbonizing takes place. Carbonaceous materials such as peat, wood, lignite, and brown coal may be used, and may be mixed with substances such as kieselguhr, fuller's earth, and gypsum, and an activating agent such as lime. The charge is delivered to the generator *A*, Fig. 1, through the charging door *18a*, Fig. 2, and a layer of broken carborundum is placed on top to filter the generator gas supplied through nozzles *12* and air passing through ports *11*, the air and gas being sucked in by means of a blower *C* placed in the circuit between gas condensers *B*, *B*¹. For starting combustion, generator gas is supplied

FIG 1.

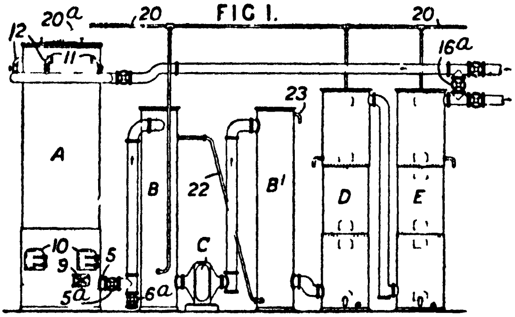
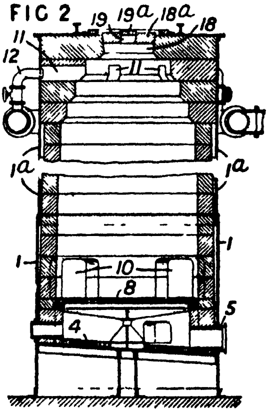


FIG 2



from a storage tank, but when the combustion is properly started the gas from the generator *A* is circulated by a blower *C* through the condensers *B*, *B*¹, a water scrubber *D*, and an oil scrubber *E*, and passes through a valve *16a* and nozzle *12* back to the top of the generator. Thus a zone of combustion and a zone of carbonization preceded by a zone of distillation are caused to travel downwards through the charge. When the whole charge is carbonized, the combustion gas is turned off, the outlet valve *5a* is closed, and water from a hose-pipe *20a* is supplied through a poke hole *19* and played on the hot carbon so that steam is produced, which drives out the air, the carbon being thereby cooled in the absence of air. The carbon may be removed through discharge doors *10* into wagons, or if it is of a pulverulent nature it may, by flooding the generator with water, be washed through the grate, and through valves *5a* and *6a* to some receptacle for further treatment, such as with hydrochloric acid to remove the lime, and is then washed and dried. The residue may be moulded, for example, under pressure with or without binding agents. Where smothered combustion of the charge takes place, the carborundum is dispensed with, and carbonizing takes place according to United Kingdom Specification 221,033, the supply of air for combustion being regulated by diluent gases or gases other than steam. The generator consists of an outer metal casing comprising a base *1* on which rests an upper part *1a*, both parts being lined with firebrick. The bottom *4* is inclined towards the outlet port *5* and is provided with a grate *8*, cleaning doors *9*, and discharge doors *10*. The top of the lining is substantially dome-shaped and contains passages *11* for air sucked in along with gas from nozzles *12*. The charging door *18* has a fireclay stopper *18a* containing the poke hole *18* with a fireclay stopper *19a*. The condenser *B* and scrubbers *D* and *E* are supplied with water from branch pipes from the main water pipe *20*. The condenser B^1 is supplied with water from the condenser *B* by a pipe *22*, and an overflow pipe *23* conducts the water back to a tank. (Specification 221,388 is also referred to.)

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C 2 (price, 1s. each) *United States* · Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

Purification of Beetroot Molasses, Distillery Spent Wash, etc., by Electrolysis, with Recovery of Succinic and Glutamic Acids, Betaine and Trimethylamine, etc. *Y. Takayama*, of Kaishi-kawa, Ku, Tokyo. *233,196*. July 5th, 1924.

Beetroot molasses, or the residue after fermentation of the same and distillation of the alcohol, is electrolysed so that glutamic, glutimic, and succinic acids, or salts thereof, are obtained at the anode and betaine and caustic potash and soda at the cathode. The molasses or fermentation residue may be run into a compartment between two diaphragms of parchment paper, etc. From the uppermost compartment containing the cathode the solution of the bases is run off continuously, while the anode products are washed away through a pipe by a stream of water. The diaphragms are inclined so that gases collect at one end and are removed by pipes. The anolyte removed may be treated with an alkali to precipitate iron, or with hydrogen sulphide to precipitate zinc. Heating with a mineral acid then converts the glutimic acid to glutamic acid, which is then isolated as the hydrochloride, calcium salt, or free acid. Succinic acid may be crystallized from the mother-liquor. Alternatively, the glutimic acid may, be converted into glutamic acid either before removal of the anode metal or, when treating fermentation residues, before electrolysis. Or the glutimic acid and glutamic acid may both be converted into calcium salts, precipitated by alcohol, and separated by treatment with water. Caustic potash and soda in the cathode product are converted into chlorides, sulphates, or carbonates and crystallized out after concentration, whilst from the mother-liquor, betaine is extracted by means of alcohol. Alternatively, the whole cathode liquid is concentrated and betaine is converted by heat into trimethylamine and distilled.

Manufacture of Active (Decolorizing) Carbon, Phosphoric Acid and Calcium Phosphate. *R. Duncalfe, R. B. Drew and J. P. Cutter*, of Barnes, London. *233,840*. March 29th, 1924.

Bonechar or bonechar dust is leached with a dilute solution of phosphoric acid in order to obtain activated carbon and phosphoric acid. Bonechar (which may receive a preliminary re-calcination) is washed with water after leaching and dried, and the combined washing water and leaching liquor is treated with sulphuric acid in amount considerably less than the equivalent of the calcium and magnesium present in solution On evaporation, di-calcium hydrogen phosphate is precipitated which may be removed and regarded as the finished product, or may be decomposed with sulphuric acid to give calcium sulphate and phosphoric acid for re-use. The filtrate from the di-calcium hydrogen phosphate is treated with sulphuric acid in quantity sufficient to precipitate most of the calcium and magnesium as sulphates. The latter are separated and the mother-liquor containing phosphoric acid is treated for the removal of the salts of magnesium and the alkalies which are present. Waste liquors which are too dilute to warrant evaporation may be treated with lime to recover their content of phosphate.

Precipitation of Tricalcium Saccharate in the Extraction of Sugar from Beet Molasses. *Carl Steffen*, of Vienna, Austria. *233,936*. July 30th, 1924.

In extracting sugar from saccharine liquids (e.g., molasses), by precipitating it as calcium saccharate by means of lime which is added to the solution as quicklime, the undissolved lime which has not entered into the reaction is separated from the lighter calcium saccharate by settling, centrifugation, etc., before the liquid containing the saccharate is passed to the filter-presses. The lime thus separated is used for precipitating a further quantity of sugar, and it is stated that if the separator is kept cool (about 15°C.), unslaked lime entangled in the slaked lime remains unslaked and the mixture is more efficient in precipitating the saccharate [1]

CONFECTIONERY (*A*) *J. C. Lloyd*, of The Heath, Cardiff. *230,703.* July 19th, 1924. (*B*) *G. Newham and H. B. Hillary*, of London *232,059.* May 22nd, 1924. (*C*) *A. Savy, Jean Jean & Cie.*, of Courbevoie, Seine, France; and *Baker Perkins, Ltd.* *232,614* April 16th, 1925; convention date, April 16th, 1925.

(*A*) A boiling plant is disclosed comprising a steam generator, one or more steam jacketed pans heated by the circulation of steam through pipes, and an automatic steam trap for returning condensate to the generator. (*B*) This refers to the formation of ropes of confectionery into sweets by passage between a pair of rings by way of an equalizing and rounding device. (*C*) In the production of confectionery, "sweetmeats are partially coated by allowing the stream of coating material to fall only on the portion of the sweetmeat to be coated."

MANUFACTURE OF GLUCOSE (DEXTROSE OR GRAPE SUGAR). (*A*) *Corn Products Refining Company*, of New York (Assignees of *W B. Newkirk*, of Illinois, U.S.A). *232,160.* September 22nd, 1924, convention date, April 11th, 1925. (*B*) *Corn Products Refining Company*, of New York (Assignees of *J. J. Merrill*, of Chicago) *232,584.* April 3rd, 1925; convention date April 18th, 1924. (*C*) *Corn Products Refining Company*, of New York (Assignees of *W. B. Newkirk*, of Illinois). *232,938.* March 30th, 1924, convention date, April 25th, 1925.

(*A*) In producing crystallized glucose from starch conversion liquors the crystallization is started by the addition of a considerable quantity of crystals of the type desired in the form of "foots" or crystallized liquor from a previous operation, the mixtures consisting of about 40 per cent. of "foots" and 60 per cent of fresh liquor. It is stated that in this way the operation can be carried on through a much greater range of temperature than is possible with a smaller amount of seed crystals. The liquor after concentration is cooled to a suitable temperature and then mixed with the "foots" in a vessel separate from the cooler. In preparing hydrated crystals, the crystallization can begin at 105°F. and the temperature be gradually reduced to 80°F.; whilst for anhydrous crystals the initial temperature may be 130-145°F. and the final 100-120°F. (*B*) Pulverulent material, such as crystalline dextrose, etc., is dried during its passage from a shoot through rotary cylinders to a discharge conveyor by hot air or gas which is drawn through a heater into the feed end of the cylinder and forced through a cyclone separator and pipe into the discharge end of the cylinder by a fan. The dust-laden gas is discharged into a separator in which the precipitation of the dust is assisted by steam jets issuing from a perforated ring. The heater consists of a casing containing steam coils. (*C*) The glucose-containing liquor resulting from the hydrolysis of starch is concentrated and cooled to yield crystalline glucose, the usual bonechar filtration prior to concentration being preferably substituted by filtration through a non-decolorizing material. The glucose is separated in a centrifugal machine and the mother liquor again concentrated and cooled to give one or two further yields of glucose. The glucose obtained is collected and redissolved and the solution filtered, preferably through bonechar, the filtered solution being concentrated, cooled, and allowed to crystallize. The crystals are separated as before and the mother-liquor again concentrated and cooled to give a further yield. Suitable conditions for crystallization are indicated, and each crystallization is carried out by mixing the solution to be crystallized with a quantity of the magma remaining after the crystallization of the corresponding solution from the preceding batch, the quantity of residual magma amounting preferably to about 40 per cent. of the contents of the crystallizer; the nature of the crystals in the residual magma, i.e., whether hydrated or anhydrous, largely determines the nature of the crystals obtained from the fresh liquor. (Specifications 227,140 and 232,160 are referred to.)

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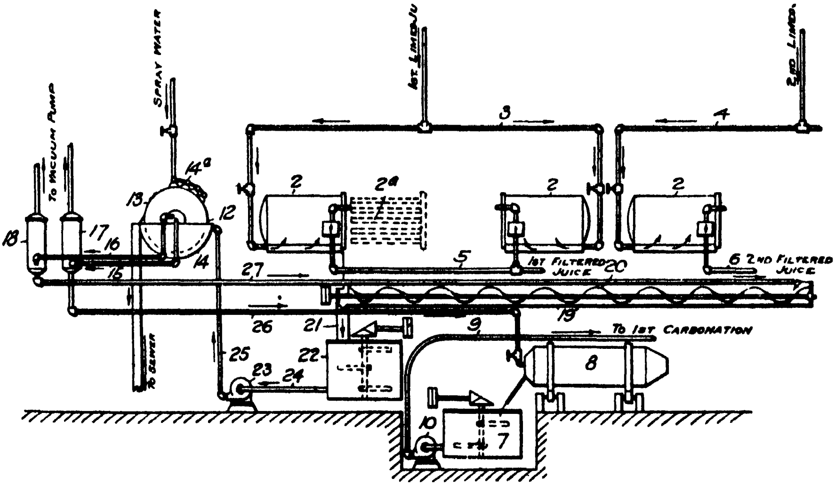
[1] See also U.K. Patent, 228,741, *I.S.J.*, 1925, 228

UNITED STATES.

Washing Filter-press Scums in the Carbonatation Process. *Edwin Morrison* (assignor to *The Great Western Sugar Co.*, of Denver, Colo, U.S.A.). *1,528,501.* March 3rd, 1925.

Objects of the invention are: (1) primarily to shorten the periods of inactivity of the filter-presses by providing means for filtering and washing the cake in a separate and concurrent operation; (2) to increase the quantity of sugar produced by a more complete extraction of the sugar content of the cake; and (3) to economize in the use of water, and consequently to save in fuel consumption for the evaporation of the sweet-waters. Broadly stated, the process comprises the production of an enriched sweet-water for use in preparing the hydrated lime charge by mixing lime mud derived from the filtering of raw carbonatated limed juices with sweetened wash-water, filtering, and utilizing the still further enriched sweet-water of relatively high sugar content to prepare the hydrated lime charge, whereby the volume of water is reduced to a minimum. It is a continuous one and provides for the extraction of the sugar contents of mud discharged from the ordinary intermittent filter-presses in a continuous operation, the latter being accomplished by the employment of a continuous auxiliary filter. In its operation a system of co-operatively connected devices is provided, these being shown in the accompanying drawing in which the reference numerals *2* designate the usual filter-presses which receive their charge through pipes *3* and *4* and which discharge their filtrate through conduits *5* and *6*. A milk-of-lime obtained from a lime slacker *8* is thoroughly stirred in a mixing vat *7* and the mixture is delivered through a pipe *9* to the carbonatation vats by the use of a pump *10* where it meets with the raw juices. In carrying out the invention one employs an auxiliary filter *12* preferably of the continuous air-pressure type in which a partially submerged rotary carrier covered peripherally with a porous filtering fabric, is the medium for separating the sugar-charged liquid from a mixture of liquids and solids. The carrier has beneath its porous covering a plurality of circumferential compartments in connexion with a common outlet and the liquid contained in material collecting upon the service of the the carrier is expressed into the compartments by an excess of external pressure produced through a partial vacuum at the outlet or other convenient expedients The solids deposited upon the circumference of the carrier are subjected to a wash after its immergence and the wash-water carrying the remainder of the sugar contents of the charge is discharged separate from the first filtrate through the medium of an automatic valve movement connected with the carrier. In the drawing the reference numeral *14*



designates the tank of the auxiliary filter, *13* the rotary carrier, *14a* the system of conduit through which the wash-waters are supplied, *15* the discharge pipe for the first filtrate, and *16* the discharge pipe for the second or wash filtrate, both said pipes being connected with a vacuum pump through the intermediary of receivers *17* and *18*. A trough *19* is disposed beneath the filters to receive the mud collected on their frames *2a*, after the latter have been withdrawn from their respective housings as indicated in broken lines, and a screw conveyor *20* works in the trough to carry the mud to a discharge-opening at an end thereof, which by means of a spout is connected with a mixing vat *22*. A pump *23* draws the contents of the vat through pipes *24* and *25* to the auxiliary filter, the filtrate discharged from the auxiliary filter through the conduit *15* is conducted to the lime slacker *8* through a pipe *26*, and the sugar-charged wash-water drawn from the filter through the pipe *16* is conveyed to the trough *19* through a pipe *27*.

In the operation of the process, the limed juices after carbonatation are conducted to the filter-presses *2* in which the liquid is expressed from the lime mud which collects on the filter-frames. After the filters are filled with solids to their full capacity and the surrounding juice has been discharged, the frames are withdrawn from their housings as indicated in broken lines in the drawings and the mud cakes adhering thereto are caused to drop into the receiving trough *19*. The lime-mud together with the sweet wash-water supplied from the auxiliary filter through the conduit *27*, is conveyed to the tank *22*, in which they are mixed by mechanical agitation. The lime-mud milk thus produced is pumped to the auxiliary filter in which the entrained sugar is removed from the solids carried in suspension as hereinbefore explained, the first filtrate being conducted to the lime-slacker through the conduit *26* for use in preparing the charge for the filter-presses and the second filtrate or sweetened wash-water being discharged into the trough *19* for use in diluting the lime-mud removed from the filters. The mud adhering to the carrier of the auxiliary filter after the washing operation is completed, is removed by a scraper or other suitable means and discharged as waste. It will be understood that in case the discharge from the auxiliary filter is insufficient to dilute the mud cakes discharged from the filters to the desired density, liquid obtained from other sources may be supplied to either the trough *19* or the mixing vat *22*.

From the above it is clear that in this process water is only used to wash the mud in the second press or set of presses and the enriched sweet-water is added to the lime mud from the first presses to form a lime-mud milk. Thereafter the latter is filtered on the second press or set of presses to produce a sweet-water still further enriched in its sugar content. The latter is used to prepare the charge for the first set of presses. This is to be distinguished from the processes at present in use in which a mixture of water and sweet-water is used to prepare the charge for the first presses While in the prior art processes and in this process the term "sweet-water" is applied to the fluid used to prepare the hydrated lime charge, there is a great deal of difference in the quality and the sugar content of each, due to different handling through each process. The new process saves water and fuel to finally evaporate this water by causing this water to perform three continuous functions. (1) Wash the final mud; (2) elutriate the mud between the first and second presses; and (3) in combination with the incoming new lime hydrate, to prepare the charge for the first presses. In the prior art processes the water is uneconomically used, as it is divided, part being added to the mud in the first press or presses and part in the second press or presses, the mixture being used to prepare the charge for the first press or presses.

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BAGASSE TREATMENT TO OBTAIN SUITABLE FIBRES FOR PAPER PULP AND BOARDING MANUFACTURE. (*A*) ***John K. Shaw***, of Minneapolis, Minnesota, U.S A. *1,501,924*. July 22nd, 1924. (*B*) ***Treadway B. Munroe***,[1] of New Orleans, La., U S.A. (assignor to ***C. F. Dahlberg***, of Minneapolis, Minnesota, U.S.A.). *1,503,202*. July 29th, 1924.

(*A*) In carrying out this invention, it is explained, the bagasse (or analogous fibres) are only partially "cooked" in the manner as is disclosed in co-pending application, serial number, *419,044*, filed October 23rd, 1924. That is, the fibres are subjected to any suitable chemical such as an alkali, a sulphate, or a sulphite, and cooked only so long as is necessary to loosen up the "encrusting casing" of the fibres and not sufficiently long to dissolve out a substantial portion of the valuable natural pith with which said fibres are accompanied. Thus not only a minimum quantity of chemicals is used up, but the valuable wall board making pith is preserved. After the bagasse (or analogous fibres) have been thus partially cooked, they are submitted to the action of a suitable beating engine, whereupon a portion of the longer partially cooled fibres with their natural pith is recovered this portion being mechanically separated from the shorter fibres also accompanied by their natural pith. The shorter fibres which are not separated from the natural pith are used for board making purposes precisely as is disclosed in the co-pending application, but may also have added thereto the dissolved cellulosic constituents and pith of the longer fibres. The first mentioned portion of fibres, however, which also has not as yet been separated from its natural pith, is further cooked in any suitable chemical solution to such an extent as will dissolve the pith and form paper-making fibres therefrom. These said fully cooked fibres are found to make very high grade pulp from which a superior grade of paper can be manufactured. It will now be clear that by following the procedure above outlined, one avoids dissolving a large portion of the pith in treating bagasse fibres, and therefore avoids the great loss of cellulosic material that has been heretofore experienced by practising other cooking processes By saving this pith with the board-making fibres, all loss of the same is avoided, because the mechanical separation of the two classes of fibres saves not only the pith but a considerable amount of the short fibres which are valuable for the manufacture of the heat insulating wall boards. While it is true that some of the cellulose material of the long fibres will be lost during the second cooking, yet this loss does not amount to anything like the total loss that is experienced in the prior processes, whether the pith is mechanically stripped from the fibres before the cooking, or is completely dissolved therefrom during the cooking. It is found in practice that it takes a less weight of chemicals to make a ton of paper making pulp by this process than by the ones prior, the valuable board-making material being obtained in addition as a by-product.

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[1] See also U.S. Patent, 1,479,419, *I S.J.*, 1924, 620, and U.S. Patent, 1,501 925, *I.S J*, 1925, 60.

(*B*) If a mass of bagasse after leaving the mill is exposed to the weather in a hot climate as is usually done, owing to its content of moisture, sugar, and gummy matters, there will first set in an alcoholic fermentation, which is followed by an acetic acid fermentation, which two fermentations if not checked will consume substantially all the sugar and gummy matters present. If now the mass is still permitted to lie out in the weather, a humic acid fermentation will set in, which will destroy the strength of the fibres, and render them unfit for pulp making purposes. In addition to this, if the bagasse is baled, the acids formed will act on any iron present, such as the bands surrounding the bagasse mass, to form ferrous acetate, which with the advent of more air forms ferric oxide, this becoming hydrated and reacting with the tannic acid present to form a black ferric tannate thus discolouring the fibres. But the foregoing objections are obviated in this invention by proceeding as follows: To the interior of the mass of bagasse is added at any time prior to the completion of the acetic acid fermentation any suitable insoluble compound having an alkaline reaction, such as lime, crushed limestone, crushed oyster shells, etc., either dry or mixed with water. The lime containing mass is subjected preferably in a baling press, to a pressure sufficient to form over a portion or all of its surface, compacted, substantially air impervious layers of fibres cemented together by the said sugar and gummy matters present in the bagasse. Thus the inventor is enabled to prevent to a degree the destruction of the strength of the fibres, as well as a decolorization thereof.

Solidified Fuel containing Alcohol and Kieselguhr. *Robert Calvert* (assignor to *The Celite Co.*, of Los Angeles, Calif., U.S.A.). *1,523,580*. January 20th, 1925.

Claim is made for "solidified fuel" containing approximately 29 parts of diatomaceous earth (kieselguhr), 68 of alcohol, and 3 of soap, by weight.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs)	1925 Tons	1924 Tons
Total Receipts, January 1st to July 29th	2,232,770	2,146,639
Deliveries ,, ,,	2,103,624	2,085,712
Meltings by Refiners ,, ,,	2,014,930	1,964,710
Exports of Refined ,, ,,	147,000	109,000
Importers' Stocks, July 29th	129,146	61,721
Total Stocks, July 29th	230,197	187,962
	1924	1923
Total Consumption for twelve months	4,854,479	4,780,684

Cuba.

Statement of Exports and Stocks of Sugar, 1922-1923, 1923-1924, and 1924-1925

(Tons of 2,240 lbs)	1922 23 Tons	1923 24 Tons	1924 25 Tons
Exports	2,602,339	2,605,959	3,063,394
Stocks	590,209	788,141	1,121,345
	3,192,548	3,294,100	4,184,739
Local Consumption	67,500	62,000	80,000
Receipts at Port to June 30th	3,260,048	3,356,100	4,264,739

Havana, June 30th, 1925 J Guma.— L Mejer

Sugar Crops of the World.

(Willett & Gray's Estimates to July 9th, 1925)

	1924 25 Tons	1923-24 Tons	1922 23 Tons
Cane			
America	8,365,652	7,055,255	6,578,746
Asia	5,474,490	5,909,840	5,460,112
Australasia	505,680	339,859	343,832
Africa	577,406	572,035	556,853
Europe	10,629	7,871	13,918
Total Cane	14,933,857	13,884,860	12,953,461
Beet.			
Europe	7,175,000	5,057,761	4,574,325
U S.A	974,185	787,217	615,936
Canada	36,200	16,500	12,400
Total Beet	8,185,385	5,861,478	5,202,661
Total Cane and Beet.	23,119,242	19,746,338	18,156,122

United Kingdom Monthly Sugar Report.

Our last report was dated the 13th July, 1925.

The general easy and quiet tendency of the market was continued until the latter part of the period under review when Russia, entering the market for further ready purchases, caused an unexpected demand all round which could in most cases only be met by releasing "paper" cover previously put out against existing stocks. This had a marked effect on the near positions in our London Terminal Market, and August which had slumped to 15s. 2¼d. moved up rapidly to 16s. buyers, and a large business was transacted at this price. New crop months moved up slightly in sympathy, and a fresh interest was taken all round. Manufacturers and buyers of sugar, fearing to lose the opportunity of cheap contracts for the next year, covered themselves here and there for partial requirements.

The July liquidation in the London Terminal Market resulted in a slight "bear" squeeze and on the last day of the month the price was pushed up to 16s. 6d a cwt., a rise of 1s. 3d., and some lots were defaulted upon. The liquidation of August—in which a large speculative interest has existed for some months—appears to be proceeding much earlier than expected principally by "bulls" carrying forward their holdings to December and March. The latest prices are August 16s., December 15s. 10½d., March 16s. 3¾d., and May 16s. 5¼d.

In actual sugars the same cautious policy of purchasing only immediate requirements has generally been continued. Spot sugars, Dutch, Czecho and American, etc., have been doing at about 29s. 3d. The stock of Continental sugar in London, which at one time looked like being overwhelming at this time of the year, was surprisingly limited to a fair quantity of American granulated, the bulk of which, however, turned out to be a poor quality and the demand created by the Russian enquiry referred to above was centred on other marks and was principally met by the British Refiners who did a large trade in consequence. They increased their price by 3d. per cwt. making their nominal price for London granulated 30s. 4½d. and still continued to do a steady trade at the advance. For Continental spot sugar 29s. 6d. was paid and what limited stock exists is well held.

Business in raws has been small but steady. Cuban 96 per cent. were done down to as low as 11s. 9d. c.i.f. but have now recovered to 12s. 3d., Preferential West Indian 96 per cent. being about 6d. per cwt less.

The New York Futures Market has shown a steady tone for the last month and has moved up about 5 points on balance since our last report.

Reports from the Continent of the growing Beet crops are on the whole very favourable. In Czecho Slovakia the roots are in some districts even larger than they were at the same time last year. In other parts of the Continent, principally in Germany, the reports are not quite so good. The indications at present are that, given normal weather until the harvesting, a full yield should be forthcoming, and a total European crop of slightly less than last year is expected.

Early and unofficial reports estimate the next Cuban crop at between 5,250,000 and 5,500,000 tons.

21, Mincing Lane,
London, E.C. 3.
August 11th, 1925.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE

INTERNATIONAL SUGAR JOURNAL.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 321. SEPTEMBER, 1925. Vol. XXVII.

Notes and Comments.

The Problem of Labour for British Beet Agriculture.

A rather interesting Memorandum has been prepared by the British Sugar Beet Society, and submitted to the Ministry of Agriculture, on the question of providing labour for the lifting and topping of the sugar beet crop in this country. Representative enquiries have shown that though there is no universal shortage of labour, it is likely this autumn to be unequally distributed, and as the acreage sown this year amounts to 60,000 (as compared with 22,637 acres last year) it is imperative that no time be lost in formulating some scheme or other for providing against a shortage of the necessary labour to lift the crops.

But there are admittedly numerous difficulties to face. In Continental countries, where the sugar beet industry is established, a more intensive arable cultivation is practised, and a larger number of people are living on the land. In consequence, the sugar factories provide work for agricultural labourers at a time when the demand for their labour on the land is at its lowest, thus reducing the need for casual labour. But in this country there is often not enough labour to be spared from the farms to meet the full demands of the factories. When it comes to seeking casual labour, there is the difficulty that any farm workers who have entered other occupations in the towns and received unemployment pay are reluctant to return to uninsured work. Even those willing to return are afraid that the incidental regulations governing insured employment and unemployment may prejudice them if they undertook farm work for the beet lifting season. The main difficulty of extra labour is, however, housing, and any plan to provide labour on extensive lines for seasonal operations must include this necessary provision.

The British Sugar Beet Society consequently conclude that the present method by which the Employment Exchanges supply to farmers individual casual labourers for seasonal operations is not well adapted to farm work, and in the absence of any scheme that will be sufficiently effective to give the farmer the guarantee of the necessary additional labour, it is likely to be a bar to increased sugar beet cultivation and to the further erection of factories.

Briefly put, the Society advocate as the best solution of the difficulty the establishment of mobile harvesting teams for both seasonal operations of the sugar beet crop, i.e., the singling and hoeing from May to July, and the harvesting from October to December, thus transforming casual labour into continuous labour for two separate periods approximating to six months in the year. Suitable foremen harvesters with adequate experience would have to be trained and special arrangements made to provide them with work of one kind or other throughout the year. Where the scene of operations is not too far from a town it is suggested that the town should be the headquarters of the team and means of transport to their daily task, presumably in motor lorries, would have to be provided at the grower's expense. Where no suitable town was available as a dormitory, suitable living accommodation on the spot would have to be provided, possibly by means of portable wooden huts.

The problem is one that needs early solution since till we in this country succeed in getting more men back to the land, and agricultural labourers' cottages are increased in number, the supply of labour at harvest time for our growing beet sugar industry promises to lag behind the demand and correspondingly to hamper the extension of this important industry. Doubtless the point will not be lost sight of by the Ministry of Agriculture, to whom the appeal has been made.

The Uba Streak Disease in Natal.

On another page of this issue we give a summary of our present knowledge of the new disease of the mosaic type found attacking the Uba cane in Natal, as disclosed in a paper, just received, by Mr. H. H. Storey after a couple of years of close study. In reading over the description of the various stages of this successful piece of work, we must remember that the author, belonging to the Agricultural Department of the Union of South Africa, had no special call to devote himself entirely to disease in the Natal cane fields. He had, however, some knowledge of mosaic diseases; and discovering the well-known sugar cane mosaic, persuaded the authorities to allow him to probe the matter thoroughly, in order to control its spread—a matter of the more delicacy in the then conditions of the Natal industry, in that the presence of mosaic was considered as a matter of minor importance, because the Uba cane, the only commercial cane grown, was known to be immune to it. We have read of the uphill fight which Mr. Storey had in bringing home to the planters the necessity for early action; and in his patient survey of the Natal conditions, he was rewarded by the surprising discovery that the Uba itself had a disease of the same type. This at once drew marked attention, and undoubtedly paved the way for an alteration in the outlook of the planting community, and swept away any remaining difficulties as to his being allowed to give his whole time to the work. We must also remember that, at the time of his arrival, there were practically no facilities for research on sugar cane pests and diseases, and in consideration of these facts we are, we think, justified in remarking that Mr. Storey's progress has been remarkably rapid.

The study of the mosaic disease of the sugar cane, after a considerable period of chaos, has emerged as perhaps the most thorough among cane diseases; and, as has been recently emphasized in various directions, mosaic is probably the best known, in all that matters, of any of the numerous diseases which affect this unfortunate crop. And, at every turn and corner, this knowledge has helped in the elucidation of Streak, as the Uba disease is termed to distinguish it from the mosaic, which is met with now in all important sugar cane centres with the exception of Mauritius and presumably India. Streak has long been known on maize in South Africa and appears to be somewhat virulent on that crop; but, although it has been met with in every Uba field examined in Natal and Zululand, and also on a number of other cane varieties, fortunately its effect on the cane appears to be distinctly less harmful than mosaic. Nevertheless, its stunting action is readily recognized, and there is little doubt that the crop is diminished by its presence. Although it resembles mosaic in many features, it is quite distinct from it, and in the difficult matter of control a long vista of work is opening up for the more scientific study of the cane crop in Natal. Mr. Storey's various published papers on the subject will be widely read by those interested in the study of mosaic diseases in plants, and are a solid contribution to the mass of literature which has accumulated around this difficult subject.

While on the subject of the Natal sugar industry, it may be added that after prolonged negotiations the question of financing a sugar experiment station by means of a loan of £10,000 from the Union Government seems at length to have reached a successful issue. According to a *Times* correspondent the station, which will be 60 acres in extent, is to be started on land leased by the Natal Estates, Limited, for a period of 99 years upon very generous terms. Preparatory arrangements have been made with a view to erecting the buildings, while a large proportion of the equipment for the laboratory has reached Durban. When completed the station, on which boring for water has already commenced, will be the centre of scientific research for the sugar industry in Natal.

Agricultural Progress in *Mauritius*.

On another page we give at some length the annual report of the Mauritius Department of Agriculture. It is interesting as revealing the extent to which the up-to-date sugar planters in that island are endeavouring to overcome the increasing difficulties of the labour supply (and also, we take it, of beasts of burden) by the introduction of suitable mechanical implements and tractors. Labour even in the tropics is ceasing to be the docile unorganized handmaid of industry. Thanks in part to the war, it has tasted the joys of a rate of remuneration that previously it had never experienced, and is now no longer willing to put the same energy into a day's work, or to be content with the old ideas of a day's appropriate pay. We are not concerned here to discuss the ethics of the change; it is an inevitable result of the trend of modern education amongst all races. But it has to be accepted as an established factor in industry, and those sections who, hitherto relying for their profits on the cheapness of labour, now turn their energies to devising mechanical ways and means to replace that former abundance of hand labour are the most likely to maintain the virility of their industry.

In Mauritius numerous experiments are being carried out with different types of ploughs and tractors, some of them of local design; and one is glad to note that some well known British makes are meeting with a measure of success in competition with the more widely-used American types. Ploughs destined to make planting furrows either square-sided or round bottomed (local opinion is divided on the respective merits of the two types), ploughs to bury cane straw in the fields, ploughs for uprooting cane stools, etc., are all being tried. As for the tractors, the caterpillar type has so far achieved most satisfaction. the wheel tractor types hitherto employed being found too light and under-powered for the heavy Mauritius soils. But it is held by many that more powerful and heavier types of the wheel tractor may eventually oust the caterpillar type, owing to the lower initial cost and smaller repairs bill. What is clear is that Mauritius is successfully grappling with the solution of ideal implements for its sugar industry, and the process of evolution will be watched with interest by other sugar agriculturists.

The Mauritius College of Agriculture.

The report on the College of Agriculture for the year 1924 states that with the advice and concurrence of the Board of the College a change has been made in the date of commencement of the College Year. Previously this began in September, but under the new arrangement it will now commence in January. The arrangement has the advantage that it synchronizes with the commencement of the scholastic year of the Royal College and other secondary schools. Six first-year and three second-year students completed their curriculum in June, while four third-year students completed their training at the same date. Preliminary and Final Examinations of the City and Guilds of London Institute in Sugar Technology were held in May, 1924. Nine candidates presented themselves, of whom seven succeeded in satisfying the examiners. By the end of 1924, the new College buildings were practically ready for occupation, all the equipment and supplies having been received.

Java and its Sugar Industry.

A correspondent of the *Times Trade Supplement* in a communication describing the prosperity of Java's sugar mills points out that that Dutch colony is almost exactly the size of England (i.e., without Wales and Scotland) and about the same population, roughly 26 millions. Cuba, slightly smaller in area, has a population only one-twelfth that of Java. Sugar estates are confined mainly to the central and eastern parts of Java, and most of the 180 plantations are in Dutch hands. Some 4000 Europeans are engaged in the industry, while the number of natives employed during the crop season amounts to nearly one million. The cost of production may be put down at about £15 per bouw (1¾ acres), but to this must be added the administrative and factory costs. A bouw will produce on an average 7 or 8 tons of sugar. The total output for 1924 was 1,721,766 tons; 31 per cent. of the buyers were Europeans, but the largest purchasers were the Japanese, who took 35·9 per cent. of the crop and have been, during the past three or four years, taking a much greater interest in the Java sugar market. The Chinese are the only other nationality which evinces interest, their purchases being 30·5 per cent. of the total.

During the war naturally little was done on the Java sugar estates in the matter of replacements, and repairs of a temporary nature only were carried out. Immediately following the armistice, preparations were made for completely overhauling estates. But there followed at the end of 1920 the slump from which the world is now only slowly recovering, and much of the work of improvement which was not urgently required was abandoned pending a return to normal times. There seems now, according to the *Times* correspondent, every possibility of extensive renewals and repairs being carried out this year, and in subsequent years, in the Java factories. Besides sugar machinery proper, there is always a demand for such items as driving belts, electric accessories and fittings, pipes, rubber valves, technical instruments, etc. It should not be impossible for British trade to secure a share of the orders pending, though competition is keen and the rate of exchange rules adversely in many cases.

Notes and Comments.

Affairs in Australia.

The final session of the Federal House of Parliament in Australia under the Bruce-Page Government terminated this summer, and we note from our contemporary, *The Australian Sugar Journal*, that it has not been without benefits to Queensland sugar interests Perhaps foremost amongst them comes the announcement of the intention of the Government to reorganize the Institute of Science and Industry to enable investigation and research to be carried out more effectively. Seemingly the Institute has long been starved for want of essential funds, with the result that its work has been nothing like as effective as could have been desired in the interests both of primary and secondary industries of the Commonwealth. Australian sugar producers are anxiously looking for some help in the scientific investigation of various phases of the subject of power alcohol production from molasses, sugar cane, and other crops This question naturally is engaging the attention of both branches of the sugar industry, as it is felt, and rightly so, that the future prosperity of the sugar areas hinges largely upon a profitable use being made of the by-products such as molasses and bagasse, and upon the establishment in this way of alternative sources of revenue to those engaged in the industry It is the peculiar province of the Institute of Science and Industry to deal with such matters, and there seems now a greater likelihood of its obtaining and disseminating much useful information for the benefit of the sugar and other tropical industries Incidentally, the Government are pushing on their measure for a bonus on power alcohol production, but no details are as yet available

Another point that is receiving the Australian Government's attention is the regulation of the number and types of aliens admitted to the Commonwealth In the North Queensland districts there has been a tendency of aliens arriving for some time past to seek employment in areas carrying already their quota of non-British residents The problem, according to our contemporary, has become one of great seriousness, not only for those of British race, but also for peoples of other nationalities already settled in certain of the sugar districts, who are apt to find the situation not a little embarrassing Hence it is hoped that the Immigration Restriction Act will be amended to deal with this aspect of the matter.

Machinery Additions to Queensland Sugar Mills.

The Director of Sugar Experiment Stations, Queensland, in the course of a report on a seven weeks' itinerary of the northern sugar districts of Queensland, gives particulars, *inter alia*, of the improvements to plant and equipment that some of the local factories are effecting. The following details are culled from that report.

At Inkerman Mill a new Babcock boiler has been installed with a chain feed mechanical stoker for burning coal. This will be watched with considerable interest in view of the possible utilization of the bagasse in manufacturing "Celotex." At Kalamia mill four additional crushing units have been installed which will provide eight crushing mills in all—the largest plant of its kind in Queensland. New effects, vacuum pans, and two new boilers (B & W.) are being put in, while a new locomotive and 150 additional trucks have been supplied. All these improvements will render the Kalamia mill practically a new one of high efficiency. At Mourilyan a new Mirrlees Watson mill has been put in for this season's crushing, also a Torricellian system for the effects. At Tully the new sugar mill ordered from Messrs. Walkers by the Queensland Government is being completed. This is described as an exceptionally fine plant; it includes electrical machinery, and there are to be six boilers made by Messrs. Thompson, of Wolverhampton, of a type different from those usually found in sugar mills.

At Mossman mill great improvements have lately been carried out. A new pan of 15 tons sugar capacity, made by Messrs. A. & W. Smith & Co., has been installed, while a new crushing mill by the same firm has also been erected. This mill now possesses a plant capable of treating 1000 tons of cane per day.

Sugar in Argentina.

A special Argentine Supplement to the *Times* last month contained some particulars by Major R. G. A. LLOYD of the sugar industry of that thriving South American republic. Unlike many of the other Argentine industries which are financed and managed by foreign interests, the sugar industry is carried on almost entirely by Argentines as regards administration, management and labour, the few foreigners employed serving chiefly in a technical capacity, as chemists or engineers. Of the £30,000,000 invested in the sugar industry, 80 per cent. is Argentine capital. Sugar is grown in the far northern provinces of Tucuman, Salta, Jujuy and Gran Chaco, between the 22nd and 28th parallels of latitude (the limits roughly of Natal and Queensland) and is the mainstay of the populations concerned. Even there however the temperature during the cold season (owing to the comparatively high altitude) often falls too low, and much loss from frost is the result. Rainfall is rather scanty and large quantities of water are required for artificial irrigation. The soil nearer the mountains is richer in moisture and produces a more luxuriant growth than the soil of the plains further from the slopes, but these plains on the other hand produce canes with a higher sugar content.

The yield of cane per hectare (2½ acres) under favourable conditions should reach from 25 to 35 tons, but the average yield in a normal season is considerably less. The average yield of sugar per cent. of the weight of cane is normally between 7 and 8; the sucrose content of the cane varies between 10 and 14 per cent. The price paid for cane by the factory to the planter varies between 12 and 14 pesos per ton of 1000 kg., the cost of railway transport and cartage being borne by the planter.

Argentina's sugar factories are in general well equipped. The amount of sugar produced by them has during the last 30 years been sufficient to meet home demands—about 260,000 tons yearly—with the exception of occasional shortages in bad seasons. The long distance from the coast (from Buenos Ayres to Tucuman is about the same distance as from London to the Shetland Islands; the Pacific Coast, inaccessible across the Andes, is much nearer in actual mileage) and the consequent cost of transport render the production of sugar for export impossible in present circumstances. But, nevertheless, the sugar industry in Argentina is in a flourishing state, and given stable and judicious political conditions and reasonably favourable seasons, its future seems commensurate with the energy and enterprise of its pioneers.

Questions in Parliament have elicited that the total estimated capital cost of the six English beet sugar factories now in course of erection is £1,826,000, of which £1,563,000 or over 85 per cent. is being expended in this country.

The Government have refused the application made by the Fertilizer Manufacturers' Association for the imposition of an import duty of 7s. 6d. per ton to be levied on superphosphate, being unable to take the view that unfair foreign competition obtains at the present time.

Fifty Years Ago.

From the "Sugar Cane," September, 1875.

In this number of our predecessor, the Editor had reproduced part of the specification of the patent granted to EDWARD CHARLES HOWARD for his invention of the vacuum pan. It was a lengthy statement, which discussed in some detail the physics involved in the principle and the practice of evaporation under reduced pressure. Space may well be found here for an excerpt from this classical specification:—

"And thirdly, I do declare that, as one of my improvements, instead of evaporating as in my said specification any saccharine solutions, syrups, or liquid sugar, I do evaporate the same in a close vessel, heated by any means, but in preference by steam, and do make and keep up a vacuum more or less perfect in the said vessel, but by preference so perfect at the commencement of working as to support not more than one inch of mercury; and of the various means by which this may be effected, I do prefer and employ a pump with a condenser of steam by injection, as used in the steam engine, and I further declare it to be highly advantageous that the pump be kept in constant work, in order to effect the most rapid evaporation, although it may be found that the vacuum may continue, as shown by the gauge, equally perfect, or very nearly so, during any intervals in which the working of the pump may be discontinued. And I do further declare that the density of the solution required to be produced by evaporation may be ascertained by the use of the several parts of the apparatus hereinafter described, by the common trial or proof of tenacity, or other variable quality, and the same may be known by means of a thermometer immersed in the same solution, but most readily and uniformly by observing the temperature at which the solution, whilst fluid and without grain, can be kept boiling under different pressures, the said pressures being shown by any gauge or fit instrument denoting pressures, and communicating with the vacuum . . . . ."

It seems also of interest to give extracts from an article entitled "Improvements in the Distillation of Rum," by Prof. HOFFMANN, late Island Chemist, Jamaica, which had been written in 1860, and published in a local newspaper. "We have been trying alum in the still-house here, and find that it has a magical effect. . . . . It requires some enterprising individual to put a high price upon his pretended secret, in order to draw attention to it. . . . . There is only one way in which alum can act upon wash, and that is by the sulphuric acid, or oil of vitriol, which it contains. . . . The action of alum or sulphuric acid can be readily explained. When cane juice is defecated by lime, a part of the lime goes into combination with the aluminous matter, organic acids, etc., another and a greater part combines with sugar and forms what is called saccharate of lime. This saccharate of lime is found in the molasses. It is an antiseptic substance, and prevents or checks fermentation, so much so that cane juice, when mixed with a sufficient quantity of lime, may be preserved for many years perfectly sound. By adding sulphuric acid to the molasses and skimmings, the saccharate of lime is completely decomposed, gypsum is formed, and the sugar is liberated. Dunder acts in precisely the same manner, as it contains large quantities of acetic acid. However, the acid in the dunder is rarely sufficient to decompose the whole of the lime salt, especially on estates where large quantities of temper lime are used for defecation. . . . "

British Beet Sugar.

New Projects and Arrangements.

A new arrangement of some interest to the sugar machinery trade is provided in the announcement that Messrs. Armstrong, Whitworth & Co., Ltd., the Newcastle and Manchester engineers, are entering into a close working agreement with Messrs. Breitfeld Danek & Co., of Prague, for the erection and installation of beet sugar factories in this country and probably also cane sugar factories in other parts of the world. The English firm will be the contractors and erectors, while the Czecho-Slovakian one will act as consulting engineers and technical advisers. The 25 per cent. of the machinery which is allowed to be imported under the Sugar Subsidy Act will doubtless be produced at Prague in the form of highly specialized units of beet sugar plant. No information is yet available as to the location of the first factory that the two firms propose erecting; but since it can only be made ready for the 1926-27 campaign, no hurried decision seems called for.

The newest factory of the Anglo-Scottish Beet Sugar Corporation seems fixed for the Selby district of Yorkshire. A site has been chosen and some 60 acres of land purchased. It will be of the same dimensions, we understand, as other "Anglo-Scottish" factories. Plans are also mooted for a factory under the same ægis in the Chelmsford district of Essex; but we are informed on good authority that nothing yet has been settled with regard to this project.

Other projects which are mooted include a factory in Surrey at Frimley where a syndicate, backed chiefly by foreign capital, are said to be completing their arrangements; and a factory in Central Wales in the Brecon and Radnor district which the British Sugar Beet Society are advocating, but which is subject to farming interests being sufficiently aroused.

The Sankey Sugar Company of Earlestown, Lancashire, continue to interest themselves actively in getting Lancashire and Cheshire farmers to experiment with sugar beet cultivation. Sowings have been undertaken this year on quite a large scale, as many as 250 farmers having taken a hand in it. This year's roots are being sent to Kelham factory, but as soon as a regular and adequate supply of beetroots is assured, additions of machinery will be made to the Sankey refinery to enable the Company to deal with 1000 tons of roots daily.

Sugar beet lifter trials are to take place on the Kelham estate, Newark-on-Trent, on Tuesday, October 13th. A number of entries have already been received by the Royal Agricultural Society of England, which is supervising the trials.

In accordance with the decision of Parliament when passing the Sugar Subsidies Bill, the finances of the subsidized companies have been made available for public inspection. The following are the published particulars of the three firms concerned.

The balance sheet, as at March 31st, 1925, of Home Grown Sugar, Ltd. (Kelham Factory), showed total liabilities of £493,696 11s. 5d., the balance on revenue account for the year being £3125. On the assets side the factory, buildings, plant, and machinery figure for £289,683 14s. 2d., and the cash at bank and in hand amounted to £7369 16s. 1d.

The English Beet Sugar Corporation, Ltd. (Cantley Factory), in their balance sheet show total liabilities of £673,281 12s. 11d., including a general reserve of £50,000, and balance on profit and loss account of £67,568 8s. 4d. The assets comprise a sum of £376,316 15s. 6d. for land, buildings, plant and machinery, with cash at bankers and in hand amounting to £216,047 2s. 6d There is a balance of subsidy outstanding of £8736.

The balance sheet for the year ended February 28th, 1925, of the Anglo-Scottish Beet Sugar Corporation, Ltd. (Colwick Factory), shows total liabilities of £368,867 7s. 2d., including a loan of £90,000 guaranteed by the Treasury, and secured over the assets of the Corporation. The assets comprise an item of £285,681 4s. 6d. expenditure to date on factories at Nottingham and Spalding, which, less £4000 depreciation for period to date, leaves £281,681 4s 6d , while sundry debtors, including Government subsidy, figure for an amount of £48,559 10s. 2d , the cash balance remaining at £247 12s. 1d

Sugar in Czecho-Slovakia.

(Dept. of Overseas Trade Report).

The production of sugar in Czecho-Slovakia shows progressive leaps from that of the year 1920-21 to 1923-24, and again in 1924-25, so a reasonable optimism as to future production may be entertained Although the level of 1912-13 has not yet been reached, the 1913-14 production of 1,268,685 tons has been passed. This means that Czecho-Slovakia has managed to bring the industry back to normal, despite the economic after-effects of the war

The following are particulars of the acreage sown in sugar beet during the last two years, 1923-24 and 1924-25, and a large increase will be remarked This increase is adequately reflected in the figures of the beet harvest and raw sugar production also given, which in the first case is 32 per cent more than the previous year, whilst production shows a 23 per cent. rise

	1924 25	1923 24	Increase on 1923 24 Per cent
Sowings in hectares	299,645	225,712	32 75
Beet in tons	7,723,200	5,839,000	32 27
Sugar in tons	1,400,000	1,022,216	36 96

The latest estimate furnished by the Union of Sugar Industries gives the figure of 1,400,000 tons as the probable raw sugar production for 1924-25, the production up to the end of December, 1924, approaching 1,340,000 tons

It may be pointed out that 1923-24 was the first post-war season in which sugar production reached over one million tons, and thus achieved two thirds of normal pre-war production The average annual production of the five previous years amounted to some 650,000 metric tons

The importance of the sugar industry of this country is shown by the export and production for the last six years During the season 1923-24 Great Britain was the best customer, taking 30 per cent of the exports

Season	Production (Tons)	Export in Tons (raw sugar equivalent)
1918-19	631,702	165,009
1919-20	507,524	340,516
1920-21	717,239	414,376
1921-22	662,520	376,328
1922-23	744,448	389,160
1923-24	1,022,216	658,228

Total exports to the end of January, 1925, amounted to 544,272 tons, as against 342,598 in the same period of last season. These exports went largely to Italy and Trieste (174,000 tons), Hamburg (140,000 tons), England (92,000 tons, compared with 79,000 last season), Austria (46,000 tons), and Switzerland (40,000). Among the other countries importing Czecho-Slovak sugar, Russia appears on the list for the first time since the war. Probably part of the sugar shown as shipped to Hamburg eventually found its way to Great Britain.

Sowings for 1925-26 production are stated to be less than during the past year, and perhaps this was to be expected in view of the fall in sugar prices that occurred last season, due to a world over-production of sugar.

Mauritius.

Department of Agriculture Report for 1924.

The annual report of the Department of Agriculture of Mauritius for the year 1924, as prepared by Dr. H. TEMPANY, the Director of Agriculture, deals as usual very fully with the sugar industry of that island. What follows is taken—in somewhat abridged form—from Dr. Tempany's report.

The crop.—The preliminary compilation of factory results for the 1924 crop gave a total of 221,000 metric tons, a reduction of approximately 7 per cent. on the normal, and comparing with 201,550 tons in 1923, 231,190 tons in 1922, and 259,870 tons in 1920. The low-lying districts were especially unfavourably influenced by the weather conditions that prevailed during the winter season; the extraction of sugar per cent. cane for the whole island averaged 10·2, varying between 10·6 in the upper districts and 10·1 in low-lying ones in the south.

Of the estimated 221,000 tons, 98 per cent. will, it is anticipated, consist of *vesou* sugar, which figure compares with 97·61 in 1923, 95·46 in 1920, and 82·60 in 1915.

The area under cane cultivation at the end of 1923 approximated to 164,100 arpents (171,200 acres), or 2300 arpents less than in the previous season. Under present economic conditions the area will probably decrease further on the same scale, as many large sugar estates have reduced their extent of cultivation.

Factory conditions in 1924.—The tendency towards centralization continues to make itself felt. At the end of the present campaign, two more factories will be closed, viz.: *Plaisance* in Grand Port and *Bon Air* in Pamplemousses. in 1925 there will thus be 48 factories operating in the colony, as compared with 59 in 1914. It is clear that as time goes by centralization to an increasing degree must be the rule; practically no factory in Mauritius as yet works at its full capacity, and the stress of modern conditions is bound eventually to lead to the elimination of the weaker usines until all the more modern factories are working at approximately full capacity.

Improvements and amelioration to factory buildings and equipment were carried out on several Estates during the year. The importations of new sugar machinery amounted to Rs. 2,172,721, while tramway material to the value of Rs. 1,168,259 was imported. In addition, small quantities of machinery were manufactured by local foundries.

Of new processes tried, one factory experimented very successfully with the Roussel process for the filtration of the whole of the juice after treatment with sulphur and lime. Philippe filters have increased their popularity during the year and several factories have installed them for the first time this crop. In two factories filters of this type specially designed for filtration in vacuo have been installed between the third and fourth vessels of the quadruple effect and have proved successful in the reduction of scale in the last body and in the production of a clear *clairce*. The use of phosphoric acid in the *clairce* is finding a wider application, and a few factories have installed new settling tanks for use in this connexion.

During the latter part of the year, Mr. R. G. W. FARNELL, B.Sc., Chemist to the British Empire Sugar Research Association visited the Colony; he was given laboratory accommodation at the Department of Agriculture, and the Officers of the Department gave assistance with his work. He attended meetings of the Chamber of Agriculture, the Société des Chimistes, and visited a large number of factories. The result of Mr. Farnell's visits has been to attract increased attention to "Indicator methods" for determining the Hydrogen-ion concentration of sugar house liquors in the control of sugar manufacture, (a point which had already been studied to some extent by the Sugar Technology Division of the Department of Agriculture during the previous crop) and to the question of the colloid contents of cane juices. As a result ten factories have so far taken steps to procure the necessary equipment for the control of the acidity of their juices by the hydrogen-ion indicator method; the introduction of these methods if properly applied should assist in improving the quality of factory work and of the final product.

The Bach process was not operated during the year; it was found that although the process resulted in a sugar of a distinctly higher grade, the practice of selling sugar by standard grade precluded any increased return for the additional cost of the process. The possibility of introducing a special higher grade of sugar in addition to the existing standards has been discussed, but so far no action has been found possible. In this connexion some interest attaches to the effort that is being made at the British Empire Exhibition in 1925 to bring specially good Mauritius white sugar to the notice of the grocery trade in England for direct consumption.

Disposal of Sugar Crop.—The Sugar Planters' Syndicate continued operations during the year and controlled more than 85 per cent. of the sugar production of the Colony. The mean prices at which the sugar crops for the years 1920 to 1923 have been sold are given below.—

1920-21	Rs. 50·68 per 50 kilos net
1921-22	12 05 do.
1922-23	13·86 do.
1923-24	18·94 do.

The mean sale price for 1924-25 will be approximately Rs. 12 50 per 50 kilos. It should however be added that in previous years the Mauritius exchange value for the Rupee closely followed that of India; in 1924-25 on the other hand the local exchange rate in relation to sugar sales averaged Rs. 14 50 to the Pound sterling while the India exchange approximated to Rs. 13·30 for the Pound sterling during the same period. Had the exchange followed that of India, the sale price would have been approximately Rs. 11·45 per 50 kilos.

Since the war and until the year just concluded the bulk of the sugar exportation has gone to Europe, the majority having been exported to Great Britain. In 1924 a considerable resumption of exportation to India occurred, due in the first place to the modification in the British preferential tariff which took place in 1924, and which caused the Indian market to offer greater advantages. Exportations of sugar to Europe and to India for the past three years have been as follows:—

CROP	EXPORT TO INDIA	TOTAL EXPORT
1922-23	267 tons	205,382 tons
1923-24	2,300 „	180,773 „
1924-25 (to date of writing)	38,816 „	178,451 „

Conditions affecting the sugar Industry.—Labour again proved the most important factor in the economic situation. The high prices obtained for the 1923-24 crop served once more to accentuate labour tension during the crop period of 1924. The importation of labour from India, of which considerable hopes were entertained, gave disappointing results, partly by reason of the terms under which labour was imported and partly because the type of men imported was not satisfactory. By the end of the year many imported labourers had returned to India, and it seems probable that shortly all will be repatriated.

There is little doubt that sufficient labour exists in the Colony to meet actual needs; the apparent shortage is due to the wave of abnormal prosperity which has passed over the Island and which has rendered the labouring classes unwilling to work, while the situation has been rendered more difficult by organization among workers, which has not as yet found its counterpart in organization among employers of labour. Owing principally to this factor the cost of production of sugar still remains at far too high a figure, and for the 1924-25 crop was on the average not below Rs. 11 per 50 kilos.

Implemental Cultivation.—Of all the directions in which economies of labour can be effected none is so important as the employment of tractors, ploughs and implements. In this connexion a number of important advances were recorded during the year; among these is the formation of a definite organization between a group of ten estates for the purpose of providing expert guidance in relation to matters affecting the use of tractors and implements.

Ploughs and tractors to the value of Rs. 186,235 were imported during the year, the number of estates employing them has augmented, and there is a noticeable increase in the tendency on the part of Estate managers to try new forms of implements and to evolve modifications of existing implements suited to local conditions. The desideratum of a plough which will make a square-sided furrow for planting, continued to attract attention, and by the end of the year one estate had actually imported a plough designed by Messrs. McLAREN & Co., with this object in view. The performance of this implement will be watched with considerable interest.

Another estate has also imported an implement designed to do similar work, but results have so far not proved satisfactory. On the other hand, several estates have experimented with a modification of the Oliver double mould-board tractor plough with extension pieces bolted to either side of the two breasts. This implement produces a wide deep furrow with a slightly curved bottom, in which planting is performed without any cleaning of the furrow by hand. Several hundreds of acres have this year been planted in this way, and in the writer's opinion procedure on these lines will probably ultimately constitute the solution of the problem. The round bottom furrow for planting is accepted as satisfactory in most cane producing countries, and it is difficult to see how or why insistence on a square-sided furrow is likely to influence the ultimate yield of cane per acre, which is after all the principal criterion.

Much attention has also been devoted on certain estates to the possibility of finding some form of plough which would satisfactorily bury cane straw in fields that are being prepared for plantation. As a result the Mon Desert S. E. Co., during the year caused to be built an implement designed to perform this operation, based on specifications of a machine used on the Pepeekee plantation in Hawaii. In its final form the implement consisted of:—An Oliver double mould-board plough with extension pieces bolted to the top of the breasts preceded by a row of disc coulters set at different heights which cut up the trash into short lengths, and thus facilitate ploughing in. The implement was tried on a considerable scale at Mon Desert Estate and gave very satisfactory results.

For uprooting cane stools and preparing land for planting, local opinion has definitely accepted the two or three furrow disc plough as the most suitable implement, particularly on account of its ability to withstand the rather rough conditions[1] which are met with in ploughing cane lands in Mauritius, and which are apt to cause considerable damage to shares or breasts in the mould board type of implement. At present the best plough for this kind of work has been proved to be Ransome's three-furrow disc plough. For ploughing out cane stools and making furrows for planting, caterpillar tractors are practically exclusively employed, the No. 1 Cletrac tractor being used on the majority of estates. Three estates employ Renault tractors for this form of work, while one estate is now using a Sanderson wheel tractor with very satisfactory results. Other wheel type tractors have not so far met with any great degree of acceptance, the types yet tried, viz., the Austin and the Fordson, being in the general opinion of planters too light and underpowered for work in Mauritius soils. It should however be mentioned that an Austin tractor working with a two-furrow mould-board plough has given fairly satisfactory results during two years at the Reduit Experimental Station for uprooting cane stools and furrowing. It is believed by many, however, that heavier and higher powered wheel tractors may eventually prove more suitable than caterpillar tractors, owing to the lower initial cost and smaller repairs bill. Experience with the Sanderson tractor on the single estate which has employed it so far tends to substantiate this view. Two other tractors of this type are expected shortly, and the importation should lead to interesting results.

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[1] The existence of large numbers of stones and boulders in cane fields in Mauritius is one of the chief difficulties in the way of the employment of tractors and implements.

For weed eradication and deep cultivation in the interlines of growing canes, the No. 3 Cletrac tractor with an Oliver No. 36 cultivator is at present considered the most satisfactory combination. For keeping down weeds, various forms of horse hoe drawn by one or two oxen are now extensively employed. The use of oxen for this type of work necessarily causes it to be slow, but so far the employment of mules has been vetoed on account of their liability to *surra*. If the campaign for the eradication of *surra* at present being carried on by the Department of Agriculture gives the results hoped for, the employment of mules should eventually become possible once more and this would probably materially improve the situation.

Exact figures for the cost of ploughing are so far not easy to obtain, but available data indicate that at present the cost of uprooting cane stools and making furrows for planting averages from Rs. 15 to 25 per acre.

So far actual planting is still accomplished by hand, but there does not seem any very obvious reason why one of the mechanical planting devices which are so widely used in Hawaii and also in Australia should not be successfully employed in Mauritius. The same remark also probably applies to fertiliser distribution. In this connexion mention may be made of a simple and ingenious device for applying molasses to canes, recently patented by Mr. H. BOURGAULT, Manager of Ferney Estate; it consists of a tank mounted on wheels of such breadth that they will conveniently pass between cane rows and is hauled by an ox; the molasses is delivered by two spouts, the flow of which can be regulated according to the magnitude of the application which it is desired to make.

It may be expected that the more thorough aeration of the land due to improved cultivation will result in increased yields; data in this respect are still lacking, but the Department of Agriculture has in hand a number of trials on some scale to test this point. It may be added that on at least one estate experience has proved that ploughing has had the effect of making the crop earlier, doubtless owing to the improved cultivation facilitating the removal of superfluous water and lessening the check due to chill from evaporation.

The present position in relation to implemental cultivation in Mauritius is full of interest; the developments which have taken place are very striking, and it is believed that in the end they will constitute the real solution of the labour problem in the place. It is for this reason that they have been reviewed at some length.

Irrigation.—Work on the various irrigation schemes continued during the year under review. La Ferme reservoir continued to irrigate some 3000 acres. The first reservoir of La Nicolière will probably be in service during the coming year; the second reservoir at Midlands is expected to take eight or ten years to complete.

The question of loss of water by seepage in feeders and distributories remains the principal problem in Mauritius, as in most other countries where the distribution of irrigation water in earth channels is practised. To remedy this defect the Public Works Department has during the past two years undertaken the lining of certain sections with lime concrete, and reports satisfactory results. In Hawaii similar trouble is reported as being dealt with by lining distributories with reinforced concrete slabs.[1] Exact measurements of the losses occurring in this way are not available, but they are estimated to amount probably to as much as between 50 and 60 per cent. of the flow in extreme cases. If to this is added losses which occur in earth channels on estates after the water leaves the Government distributories and before it reaches the fields, the total loss must be very large.

Work at the Irrigation Experiment Station was continued during the year and is now yielding significant results. The five year period for which the scheme was inaugurated terminates in 1926, and it is hoped that by the end of the present year the results which have been accumulated will enable a full report to be prepared. In the meantime it may be said that the most important point which has emerged is the fact that for every area of land there exists under definite conditions of irrigation a minimum quantity of water which must be delivered per acre, effectively to wet the entire surface. This factor varies greatly with different types of soil and also with the manner in which the water is applied, but, in any event, when the surface of the field has been effectively wetted all over, the top 12 inches or so of soil retain water to their maximum capacity; if heavier applications than this minimum are given, the excess percolates to deeper levels; there appears, however, to be relatively little transference of such excesses from the lower levels to the upper, as evaporation and absorption by the roots of plants reduce the supply of the upper levels. So far as can be seen at present, under Mauritius conditions, the water content of the top layers of the soil begins to be reduced to a point capable of affecting absorption by the plant after one week's interval from the date of application; consequently it appears that the most satisfactory way of applying water is at intervals of about one week, giving at each application the minimum quantity of water the soil can take; larger applications at longer intervals merely entail loss of water and lead to reduced yields.

It is interesting further to record that the ideal held up for irrigation practice in Mauritius is the standard of yield obtained under irrigation in Hawaii, which is in the region of 90 to 100 tons of cane per acre, after about two years' growth. At the Irrigation Experiment Station at Médine, working under the most favourable conditions, yields of 50 tons of cane per acre in virgins and 40 tons of cane per acre in first ratoons have been obtained during a total growth period of 25 months, i.e., about equal to the Hawaiian returns during the same length of time.

Pests and diseases of the sugar cane.—*Phytalus Smithi* continues to be the most serious insect pest of cane and the total number of beetles destroyed during 1923-24 amounted to 52,573,000. In the Pamplemousses area, infection continued to be intense in the neighbourhood of Beau Sejour and Mont Piton with a smaller separate sub-focus at Bon Air. In spite of all efforts it has not been found possible so far to reduce the infection to reasonable bounds at these points notwithstanding the expenditure of much effort and considerable sums of money. It is curious that while the introduced parasite *Tiphia parallella* has established itself very satisfactorily elsewhere and is greatly assisting in the work of control, it has not up to the present succeeded as well at Beau Sejour. A fact which may have some significance in this connexion is the unexpected observation that beetles from the Beau Sejour and Mont Piton areas are markedly smaller in size than others. This may be due to the drier conditions there prevailing and may possibly affect the ability of *Tiphia* to establish itself on its host.

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[1] See *I.S.J.*, 1923, 455.

Other plant pests and diseases have not been markedly in evidence; there have been reported one or two minor appearances of Red Rot, Gumming and Smut. Much attention has been focussed during the year on questions in relation to Cane Mosaic; at present Mosaic does not exist in Mauritius In January, 1924, a small consignment of Coimbatore seedlings which had been obtained from India and were growing in the Réduit Nursery were noticed to have developed typical Mosaic; they were immediately uprooted and destroyed as were all the surrounding canes; it appears that those measures have fortunately eradicated the disease.

In the middle of the year accounts received from the neighbouring Island of Réunion indicated that Mosaic disease in a severe form probably existed in that Island; in view of the proximity of Réunion, and the large amount of intercourse existing between the two places, the Government of Mauritius, on advice of the Department and the Board of Agriculture decided to send the Botanist to Réunion to investigate matters. About the same time a request was received from the French Government for the loan of a qualified Officer to report on cane diseases in Réunion. The Botanist left for Réunion at the commencement of September and spent two months in that Island. His investigations showed that Mosaic existed to a considerable extent in Réunion, particularly in the leeward districts and was responsible for very serious losses. As a result, plant quarantine restrictions have been rendered more stringent. There is no doubt that the introduction of Mosaic in Mauritius would prove a very serious matter, and would probably necessitate the abandonment of the practice of long ratooning locally practised. That the disease has not already gained an entrance is, I think, undoubtedly due to the quarantine restrictions on plant importation maintained by the Department of Agriculture during the past 12 years.

Experimental investigations in relation to sugar industry.—Research work in relation to the sugar industry has been continued during the year; the extensive series of experiments with varieties of cane have been continued on the eight experiment stations, while manurial experiments have been conducted at Réduit, Médine and on two estates. The principal points at present being investigated are:—the effects of cultivation, phosphatic manures, lime, molasses and nitrogen. It is hoped that the investigations now in progress may have become sufficiently advanced by the end of the current year, to enable the results of these to be put forward in the form of a report. Experiments on the bud selection of canes on the lines laid down by A. D. SHAMEL have been continued by the Botanist, and the Sugar Technologist, while the Chemical Division has in hand a number of investigations on soil problems, including the results of the work on the soil survey which had been suspended for some years on account of calls on the time of the Staff in other directions; experiments have also been commenced on the losses which take place in the production of *fumier* (cattle pen manure) under Mauritius conditions.

Streak Disease on Uba Cane in Natal.

In June of last year Mr. **Storey**, the Government Mycologist, Durban, read a paper describing a new disease of the mosaic type, affecting the Uba cane, and a brief summary of this paper which was couched in popular terms was given in the November number of this Journal.[1] Since then two more papers have been published, containing a wealth of detail of field observations and experiments. In the first of these,[2] the transmission phenomena described clearly indicated an unknown insect vector as the agent which attacked the leaves, and that the infection passed down the leaves into the stem, and thence upwards to the growing point and downwards to the stool. In the second,[3] the insect vector had been detected, and the passage of the infective principle to all parts of the plant had been thoroughly studied and confirmed; the whole subject was reviewed, with many additional data, both experimental and observational, so as to present a complete history of our present knowledge of the disease, in spite of the many points which require further study and elucidation. This latter paper has just been received; and it has been thought worth while to summarize here the author's work on it during the past couple of years.

Streak disease was at first believed to be a form of mosaic attacking the hitherto immune Uba cane; and in view of the campaign which had commenced to clear Natal of that disease, it became necessary to study its exact status as regards the Uba cane. It soon became evident, however, that the Uba disease was entirely distinct from mosaic, although resembling it in many respects. Conditions similar to streak were observed on ten other cane varieties, all of which were also subject to mosaic; so also on maize and a number of grasses both cultivated and wild. To avoid confusion with mosaic, sclerospora disease, and forms of chlorosis on the leaves, the name "Streak," which accurately defines the leaf markings, was adopted.

History and present position.—**Wuthrich** in 1920 wrote an article on Yellow Stripe, without any scientific description or definite data, in which he reported that this disease was widely spread throughout the cane fields, "raging to an extent that probably is not exceeded anywhere else in the world." Considering that Uba, which is free from mosaic, comprises 98·8 per cent. of the cane fields, it is obvious that it must have been included, and therefore that streak was the disease he referred to. There is a definite reference in the files of the Agricultural Department of 1914 by **Lounsbury** (Chief of the Division of Entomology) to a condition in Uba canes, which his description clearly shows to have been streak disease. The same disease appears to have been known for many years in maize under various names. **Fuller** accurately described it in a paper on "Mealie Variegation" in 1901, also noting it in a number of other plants cultivated and wild; and correspondence at that time indicates that it was present in the country for at least 20 years previously. (Considering the growing of maize on the estates, this may well have been passed on to the Uba cane at an early date after its introduction, and its present distribution supports the idea of an ancient infection). **Storey** observed it in 1922; and after an exhaustive survey, states that at present no cane areas are free from it either in Natal or Zululand, although the extent of infection varies from 1 per cent. to nearly 100 per cent. in the fields. In the coastal

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[1] *I.S.J.*, 1924, p. 583.

[2] Streak Disease in Uba, an infectious chlorosis of sugar cane, not identical with mosaic. H. H. **Storey**. Report of the Proceedings of the Imperial Botanical Congress, London, July, 1924, pp. 132-144.

[3] Streak Disease in the Sugar Cane. H H. **Storey**. Sc. Bull No. 39, 1925. Agr Dep. Union of South Africa (30 pp with two coloured plates and six illustrations in the text)

Streak Disease in Uba Cane in Natal.

Adjacent Plots in the Umbogintwini experiments at four months old. Plot on the left, streak diseased, that on the right, healthy. The Plots received identical treatment, the only difference being that the sets for the Plot on the left were cut from streak-diseased stools.

belt, south of Durban almost all fields are severely attacked, with the solitary exception of a small group of farms near Umkomaas; but, in the north, wider areas occur which are comparatively free. Similarly, in regions at a considerable distance from the coast, the severity varies, but the disease is met with in force up to an elevation of 2800 ft.

Symptoms.—These are very clearly described, and the figures, one of which is reproduced, are of great assistance. The coloured plates are especially good, being among the best we have met with in any descriptions of diseases of the mosaic type. Streak is indicated by a general reduction of size in the canes and the development of colourless areas in the leaf; but the latter are the only symptoms of diagnostic value, those of the shoots and stems being similar to normal pathological conditions due to an unfavourable environment. The whole leaf surface is covered with a series of broken, narrow, pale stripes, elongated in the direction of the veins, and more or less crowded. Although the number varies from leaf to leaf, crowding is more or less uniform throughout each leaf and the best diagnosis is obtained in the youngest leaf, the central one while still rolled up showing the pattern as plainly as the mature, and thus distinguishing the disease at once from all accidental spots and stripes which frequently simulate streak in older leaves. A somewhat detailed comparison is made with mosaic, which is obviously necessary, although from a practical point of view it is not of such great importance in Natal conditions.

Considered purely as a colour scheme (that is to say, when viewing the diseased leaves in bulk ?), typical mosaic has dark green areas on a pale ground; these are irregular, with diffused edges, frequently elongated in the direction of the veins but apparently not related to individual ones but always spreading over several. The pattern of streak on Uba leaves is of light areas on a dark background, narrow, elongated, of uniform width, and each showing a clear relation to a particular vein. This close relation to the veins seems to suggest that some substance diffuses from them which inhibits the formation of the green colour. One might describe the streak pattern as if drawn by a pen, whereas brush work would be necessary for that of mosaic. When viewed by transmitted light a pronounced difference is noted in the two diseases as to the contrast of shades: the light areas in mosaic being merely a pale shade of green or yellow, whereas in streak they are devoid of any green and almost transparent. These clear stripes are from ⅓ to 1 mm. in width and ⅓ mm. to one centimetre or more in length. In older, healthy Uba leaves there are frequently other pale spots and markings, somewhat like those in streak, and such markings have been ascribed elsewhere to insect attack, but their origin has not apparently as yet been satisfactorily settled in Natal.

In maize the markings are of a most distinctive character, although there the pen may be said to have "run," in places causing coalescence of the lines. These are usually very pale green, but sometimes quite colourless as in Uba, or even shrunken with some browning. Furthermore, in old maize leaves the pattern tends to become more striking with age, in that the lines become paler while the green of the back ground becomes intensified.

Aberrant cases are few but must be mentioned. In very young shoots of Uba arising from diseased sets an extreme widening of the lines may be met with, thus forming a pattern somewhat resembling that in mosaic, but this appearance is transitory and subsequent leaves develop the normal pattern. Again, in plants recently infected, only a few lines may appear, at the base of the leaf, frequently aggregated into groups, or may occur on one side only of the midrib, with other variations from the type; but here also this stage is transitory and fully streaked leaves are soon formed. Finally, these differences from the mosaic markings are well seen on the leaves of plants, other than Uba cane, attacked simultaneously by the two diseases, as they not infrequently are. For the rest, the patterns and appearances described show a marked unanimity in all plants attacked by streak disease.

Range of plants affected.—The full list of plants at present observed as affected by streak includes a number of other varieties of cane besides Uba ; and, considering the small number of these at present grown in Natal, this number could doubtless be almost indefinitely extended. On the other hand, comparatively few sendings of cane from Natal have occurred during recent years. But demands for "true" Natal Uba have occasionally been made, and at any rate Jamaica, Cuba and India have received such : (it would be interesting in each such case if a careful study were made of the imported canes, together with any other varieties of cane grown in their vicinity). A number of wild grasses are mentioned, and in all such cases these have been collected in close proximity to streaked Uba and other cultivated plants. Maize is of course infected, as are several cultivated cereals and fodder crops. The author, however, points out that, as transmission has not been as yet experimentally verified in most of these cases, the evidence of the plants listed being really attacked by streak rests almost entirely upon the resemblance of the leaf markings to those in Uba and maize. The full list at the present time runs as follows :—

> *Cane varieties.*—Uba, Green Natal (= Rose Bamboo), Louzier (Otaheite), Port Mackay (= Cavengerie), "Mauritius" (possibly a seedling of Uba raised in that country), Badila (N.G. 15), HQ 694 (Queensland seedling), Black Innes ? (Mauritius seedling grown under this name in Queensland), Egyptian No. 3 (probably a cane imported from Egypt under the name "Java 147"), Queensland No. 3 (identity unknown). POJ 36 and 213 appear to be immune.
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> *Cultivated plants.*—Maize, teosinte, broomcorn millet (*Panicum miliaceum*), oats, and ragi (*Eleusine coracana*).
>
> *Wild grasses.*—*Imperata arundinacea*, *Digitaria eriantha*, *D. horizontalis*, *D. marginata*, *D. ternata*, *Paspalum scrobiculatum*, *Urochloa helopus*, *Eragrostis valida*, *E. aspera*, *E. ciliaris*, E. sp. near *porosa*, and *Eleusine indica*.

The effects of streak disease on the Uba cane.—This is gone into very carefully, but the author notes that the effect is frequently masked by conditions of environment, and that this in all probability explains the fact that this disease has so long escaped the notice of the planters. There appears to be no doubt, however, that streak causes a definite stunting of the whole plant, with a corresponding diminution of the size of the cane, but exact details have not as yet been collected. Healthy plants are always markedly superior, at any rate at first. In the young plants the shoots tend to grow out laterally, and are close noded so that the leaves are crowded and arranged in a fan-like manner. The leaves are crinkled and narrow, and fail to hang in the typical graceful curve—appearances not unknown in certain other stunting diseases, such as sereh, Fiji disease, etc. These differences are more striking in dry seasons and doubtless in other unfavourable environmental conditions. One difficulty is that, although the difference between healthy and streaked plants when grown together is very obvious in the early stages, after a height of about 3 ft. is reached it is less easily observed—whether because of the close growing habit of the tall upright shoots, or indeed a partial recovery. At harvest time a definite difference is observable when canes from healthy and diseased stools are laid alongside, but this difference is not so outstanding as in the young cane plants (see Plate).

In 1923 a definite attempt was made to compare the relative weight of streaked and healthy canes grown under identical field conditions, and the result of this experiment gave a loss of 12 per cent. in the streaked plants But the method adopted is complicated by the question of tillering, it is well known that, in a stool with few tillers, the individual canes tend to be bigger that when more canes are produced The method was accordingly given up, and the exactitude of the figures is discounted In March, 1924, a series of experimental plots was laid down with the object of obtaining figures of the effect of streak upon the crop. Four plots were planted chess-board fashion, with sets obtained from a field with about 20 per cent infection The early appearance of the plots showed the usual difference in favour of the healthy sets, but later on secondary infection set in, and by December all the healthy plants had become diseased. In spite of this the plants from the healthy sets still held the lead and it is proposed to reap the crop in due course The author considers that the figures will still be useful as giving a minimum figure of losses in the locality, in the presence of secondary infection. Meantime, additional plots were laid down in the same year, and it is hoped that in some of these this disturbing factor may be avoided. The author notes, however, that plot trials of themselves are unlikely ever to give absolute figures of losses in yield For instance, it may well be that the disease is of a cumulative character, and if so the results would depend on the length of time since the streaked plants had been originally infected There is not at present any information on the effect of the disease on the sucrose content of the canes at harvest time, but it is regarded as probable that, on the analogy of mosaic, this will not be great All the same, the greater proportion of fibre in the thinner canes should have an effect on the amount of recoverable sugar

The transmission of streak disease —From the first, as was expected, the exact means by which streak disease is disseminated received the closest study, and, thanks to the results, so slowly and laboriously accumulated regarding the spread of mosaic, progress has been remarkably rapid The fact also that maize was a stepping stone to the working out of the symptoms has materially assisted. Maize is severely affected by both diseases and supplied the clue to the transmission of mosaic, and it was natural to look to it for this also in streak. This stage of the enquiry, the identification of an insect vector, has now been reached, so to speak completing the history, so far as that is possible in our present state of knowledge of diseases of this class The insect vector had not been identified at the time of writing the 1924 paper, but there seems to be little doubt that it has now been tracked down.

In the 1924 paper it was stated that transmission was invariable on using diseased sets and, once the disease appeared in a stool, no case of recovery had been met with—all the canes in the clump being affected from the first Certain cases were noted in which only half of a stool was infected, a condition repeated when these stools were ratooned, but on examining these, it was invariably found that the sound and healthy canes arose from different sets, this being rendered possible by the method of planting the sets in two lines in the furrow. But it became difficult, in the absence of all selection of sets on account of streak, to understand the extreme diversity of the percentages of infection (from 1 per cent. to 100) found in the different fields The crop raised from sets obtained from a field should repeat the amount of infection in that field. And as this was frequently far from being the case, on the analogy of mosaic, secondary infection was strongly suspected. And as the study progressed numerous instances were met with which could not be explained on any other hypothesis. For instance, a field manager first noted the streak conditions in 1916, and as it was new to him he reported it to the officers of the Agricultural Department. He then went on active service, and returning four years later was surprised to find that the disease, whatever it was, had spread to every part of his estate. Again, a set of varieties newly introduced from Queensland was planted in March, 1923, in a plot near to a field of Uba canes which was partly infected by streak. The plants as they developed were individually kept under a careful scrutiny and shot up without a sign of the disease. But in July streaked plants began to appear in one variety (HQ 694), and during the following months also in Badila and Black Innes, although every diseased plant was at once removed on the first sign of the disease. Numerous cases were noted in the fields of what appeared to be secondary infection, that is, not handed down from a diseased set. In some the leaf pattern was observable only upon one or a few shoots of a stool, the lowest leaves having no markings whatever, later leaves having streaks at the base only (i.e., on the part of the leaf last formed), while the upper leaves were fully streaked from base to apex. In roguing too, after the removal of all streaked plants derived from diseased sets, new cases continued to appear, the majority in close proximity to the places where rogued plants had been dug out. Lastly, clear cases of secondary infection were presented by plants grown only from true seed: diseases of the mosaic type are not carried in the seed. Several hundred maize plants of different varieties and from different places were sown in a greenhouse, and not one of them developed a sign of streak, whereas in a sample of the same seed sown outside a large proportion of the plants became diseased. Maize, indeed, showed itself to be particularly liable to secondary infection. But the relative time of sowing during the season had an important influence. Of an extensive series of instances noted, one Indian garden, where a succession of small plots were planted to provide fresh mealies for the market, was kept under observation from December, 1923. At that date two plots were growing, one four, and the other two months old; the four-months plot was about to flower and was found to be about 40 per cent. infected with streak, whereas the younger plot had as yet only 5 per cent. A fortnight later the first field, now ripening off, showed only a slight increase in streaked plants while the other had 30 per cent. In another fortnight this plot had 50 per cent. of the plants diseased and began to ripen off. Late in February a third plot was sown, but before the plants were 1 ft. high every one of them was attacked. Similar results were obtained in experimental plots near a greenhouse in which the controls were grown, the severity of attack by secondary infection increasing with the season, again without any cases in the greenhouse. Finally, experiments with wire gauze cages with meshes of 6, 16, 32, and 64 to the inch strongly supported the idea that some small insect vector was present. When maize seeds were sown under these cages and in the ground between them, all the outside plants were streaked within two months, and some diseased plants had appeared in all the cages of the wider meshes, while in the two fine-meshed cages none at all were to be found. This series of observations indicates the stage of the enquiry at which the author had arrived at the time of writing the 1924 paper; he concluded that the facts were suggestive of the presence of an insect vector, and that upon the drying up of diseased maize plants such insects would pass to new and younger food plants and thus spread the disease.

In the second paper the author remarks that in some places secondary infection in the Uba cane fields appears to be comparatively inactive, and indeed, on occasion, at a standstill. All attempts at the direct transfer of the disease had failed, including inoculation of the juice under mineral oil, and no evidence could be obtained of the carrying of the infection on the cutters' knives. A repetition of the maize experiment with wire gauze cages on sugar cane (meshes varying from 56 to 6 to the inch) confirmed the maize results and ruled out the transmission of streak through the soil. Meantime, he had discovered that a jassid leaf hopper (*Balclutha mbila*), which sucks the juices of maize leaves after injection of saliva, is capable of passing on the disease in that plant: in many cases where the insect was transferred from a diseased to a healthy plant the disease appeared in due course. Observations showed that the infection must pass down the leaf into the stem and thence up to the growing point, since it first made its appearance in the youngest leaves; and the suggestion was obvious that a similar rôle was played by this insect in the case of the sugar cane. A series of attempts to pass the disease by this means from maize to cane, and the reverse, ended, however, in failure. But when the leaf hopper (obtained from a place where secondary infection of the cane was marked) was transferred by a special technique from diseased to healthy sugar cane, five out of nine experiments succeeded. Therefore, "under suitable conditions it is possible for *Balclutha mbila* to transmit streak disease in the sugar cane."

A considerable proportion of the maize plants in the sugar belt becomes diseased towards the end of the season. Although transfer of the disease from maize to sugar cane has not been definitely proved, it is obvious that at the end of the season, when the maize is ripening off, the hopper begins to migrate, and sugar cane at that time of year is practically the only plant with green leaves. This insect differs in many respects from *Aphis maidis*, which is now recognized as the most active in the transmission of sugar cane mosaic: it is more robust and much hardier, and can live without food for a considerable period: furthermore, it enjoys a comparatively short period of inaction in nature, and a constant succession of broods is produced throughout the year. During the dry period all the grasses wither away and there is no maize, so that the sugar cane is marked out as its most likely food plant; but for some unknown reason, as in the Aphis, it is not a favourite, and *Balclutha* never accumulates on the sugar cane to such an extent as to be very noticeable, thus repeating the difficulty encountered in finally tracking down *Aphis maidis* as the culprit in the case of sugar cane mosaic. Nevertheless, no one can hesitate to accept the author's recommendation to the planters to avoid planting maize anywhere near their sugar cane.

With these facts and, of course, many others published or not, the author sets himself the task of accounting for the extreme irregularities in the distribution of streak disease in the sugar tract in Natal and Zululand, such as has been mentioned in the beginning of this paper. This is a line to be followed up, for only thus can control methods be confidently suggested. But in the first place, in the absence of any form of seed selection for streak in the past, it is impossible to judge of the influence of the various factors of the environment —soil, moisture, elevation, slope, etc.—on the spread of the disease. In one case, however, a certain amount of information is available from which deductions may be made. In Zululand the planting of sugar cane is comparatively recent, and the seed was obtained from an area south of the Tugela where the percentage of infection is low. There has been little exchange of seed between the Zululand planters and others at a distance since this introduction. But it has been noted that the percentage of infection is considerably greater in the flat alluvial lands than in the drier uplands, supporting the idea that secondary infection and good growing conditions of the cane have something in common. But it is not necessary for such an increase to be constantly evident; in fact, observations in other places tend to the idea that periods of activity alternate with those in which the spread in the disease is comparatively dormant. Thus all that can be said is that at some period or other conditions favouring active secondary infection have occurred in the lower lands and not in the upper. In fact, the conditions under which the insect vectors multiply on the cane and are able to transmit the disease are as yet little understood.

Seed selection is obviously important, as thus alone can the primary infection be excluded. And it is obvious from the context that this has been extensively taken up by the planters. But a difficulty has occurred in many places in the effort to obtain healthy seed cane. To meet this difficulty, STOREY instituted a system of certificates of areas of low infection (under 5 per cent.). In 1924, 38 fields were examined and 850 acres were certified. But, unfortunately, the severe drought of the year prevented the full use of this area, as it produced much less seed than expected. The author states that the quantity available in 1925 is likely to be greater. Meantime, no time should be lost in the putting down of small areas with low percentage of infection, which in a few years would give enough seed for each farm.

Roguing and isolation are obviously necessary in such cases; and to give some idea of the difficulties met with in this form of control, one case may be mentioned. At Eshowe 25 acres, isolated by a mile of veld, were planted in November, 1923, with cane below 1 per cent. infection. After some seven months, when the canes were about 3 ft. high, the manager decided to rogue, this being done with great care so that the figures of plants removed may be entirely relied on. The plants dug out in June were 360, and in the following months 284, 127, and 158; but in September the figure rose suddenly to 490, the secondary infection suggested by the slight increase in August thus becoming verified in a startling manner (a case for the idea of periodic infection activity): practically all of the diseased plants were found to be near to those which had been dug out. This experiment was thus very discouraging, and somewhat discounted the value of roguing. It is, however, only fair to note that the roguing was delayed much too long, and was thus a direct encouragement to the entrance and increase of the insect vector: the higher plants have been found to be much more favourable to its rapid increase. In a number of other cases given by STOREY a considerable amount of success was obtained, so that the general conclusion was that early roguing is needed in all cases.

Another difficulty was of an entirely different character. It was observed in several instances that, after careful selection of sets from plants with no appearance of streak, the disease appeared in the young shoots from them. This point received as usual very careful attention, and was traced to latent primary infection; that is to say, however careful the selection may be, it is always possible for plants to have been infected just before cutting, so that no external appearance of the disease had developed. The author, in view of this uncertainty as to the soundness of sets which showed no sign of the disease, made a prolonged study of the diffusion of the virus through the stool of a cane after it had been subject to secondary infection. The main result of this work is that the diffusion takes place as in mosaic—down the leaf attacked by the vector to the stem and then up to the growing point and down the stool to the other canes, where its presence is again indicated in the growing points, by the markings on the youngest leaves. In this study a considerable number of recently infected shoots were isolated, and then divided into upper and lower halves, these being planted separately and their shoots observed. In one case it was possible to detect the infection sufficiently early for the whole upper part to develop the disease when planted, while the lower part remained unaffected: in other words the disease had reached the growing point and was detected in the young leaves before it had proceeded far on its downward course to the stool This experiment was carried out on a plant with not more than 18 in. of stem, a result of considerable importance as regards control, as indicating the comparative slowness of the diffusion of the virus downwards. For when the canes are well grown it would appear to be sufficient in roguing merely to break off the canes in which early stages of infection only have been met with, in place of uprooting the whole clump—a practice already advocated with regard to mosaic when roguing is adopted in old canes.

The remaining seven pages of the bulletin are devoted to a consideration of methods of control. This cannot be adverted to here, but the general lines suggested may be gathered from the foregoing, at any rate sufficiently so at this stage of the enquiry.

C. A. B.

Filtration of Raw Beet Diffusion Juice.

By D. C. MORRIS.[1]

Anyone familiar with the manufacture of beet sugar will at once acknowledge that the most careful removal of impurities from the sugar solutions at the earliest stage possible is essential to the production of the highest yield of sugar.

In his book on beet sugar manufacture, CLAASSEN[2] stresses the importance of the early removal of impurities, and points out the effect on subsequent operations if such impurities are allowed to remain in the beet juices. To confirm this opinion, one need only visit a house which practises efficient purification, and one which does not, in order to see readily the difference in the quality of the sugar, in the evaporation and filter performances, and in the costs of operation. These are in favour of the former, other conditions being equal.

The removal of pulp and other suspended matter from raw diffusion juice by filtration has been attempted from time to time in the past as a means of improving the carbonatation operations, but these attempts have only met with indifferent success. The industry has confined its practical solution of this problem to securing as thorough a screening as possible with basket screens or devices of a similar nature. This screening removes coarse pulp and fibres in a satisfactory manner; but not the finer material, which may be colloidal in size, and which unquestionably exerts a markedly harmful effect upon the carbonatation process. Because of the slimy nature of this fine suspended matter, filtration through filter-presses with cloth as medium only is practically impossible. The filter-cloth allows much of the fine suspended matter to pass through, the remainder of the solid matter soon retarding the passage of liquid by building up a dense, slimy deposit upon the filtering surface.

With a view of investigating the practicability of the thorough filtration of diffusion juice, using Celite filter-aids, a series of experiments was conducted by engineers of the Celite Products Company in co-operation with the personnel of the Oxnard, Calif., plant of the American Beet Sugar Company. The tests are briefly described, and the results summarized, in this paper.

Apparatus used and procedure followed.—The equipment used for this work consisted of a small plate-and-frame filter-press with a total filtering area of

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[1] Engineer, Celite Products Company.

[2] "Beet Sugar Manufacture," H. CLAASSEN, p. 59

4·5 sq. ft., and fitted with suitable pump, tanks, etc., the entire layout being placed in close proximity to the raw measuring tanks.

Consideration of the problem presented three lines of procedure to determine the filtration characteristics of the juice: (1) Grade of filter-aid to be used; (2) filtration at different temperatures; and (3) filtration under different conditions of hydrogen-ion concentration.

Comparison of filter-aids.—In the investigation of the first of the above matters, three kinds of filter-aid were used, namely, "Filter-cel," "Standard Super-cel," and "Hyflo Super-cel"; the latter two materials being "Filter-cel" processed in such a way as to produce higher rates of flow. In each case pre-coating was followed in order to protect the press-cloths from the sliming solids in the juice, a surface of 6 lbs. filter-aid per 100 sq. ft. of filtering area proving sufficient. Table I shows the results obtained in comparing the three kinds of filter-aid:—

TABLE I.

Test	Filter-aid.	Per cent. Filter aid on Juice.	Temperature °C.	Filtration Rate. Galls. per sq ft per hour.
A 11	"Filter-cel"	0·20	55	4·2
D 13	"Standard Super-cel"	0·20	55	26·1
D 14	"Hyflo Super-cel"	0·20	55	39·0

The above results show that with the type of suspended matter present, more economical filter-press operation, with satisfactory brilliancy, can be expected through the use of "Hyflo Super-cel" than can be obtained with "Filter-cel" or with "Standard Super-cel." For this reason "Hyflo Super-cel" was used in most of the subsequent tests.

Effect of different temperatures.—The effect of temperature upon the rate of filtration is illustrated by the following data obtained in two representative tests:—

TABLE II.

Test.	Filter-aid	Per cent Filter-aid on Juice.	Temperature °C.	Filtration Rate Galls per sq ft per hour
A 2	"Filter-cel"	0·20	49	3·2
B 4	"Filter-cel"	0·20	85	6·7

Influence of pH concentration.—The importance of the influence of hydrogen-ion concentration in the filtration of solutions containing colloidal substances is well known; and as beet juice is a liquor of this type, a number of tests were made to determine the effect of small additions of lime upon the filtration rate. Milk-of-lime was added to the juice while in agitation until the desired *pH* value was obtained, as shown by brom-thymol-blue and phenolphthalein indicators. These indicators were used to obtain *pH* values of approximately 7·0 and 8·8, respectively. Table III shows results obtained from three filtration tests made at different degrees of alkalinity:—

TABLE III.

Test.	Filter-aid.	Per cent Filter-aid on Juice.	Temperature °C.	*pH* Value.	Filtration Rate. Galls per sq. ft. per hour.
D 5	"Standard Super-cel"	0·12	85	Raw juice	15·4
G 5	"Standard Super-cel"	0·12	85	7·0	14·5
G 2	"Standard Super-cel"	0·12	85	8·8	4·3

The addition of small quantities of lime, though affecting the filtration rates, does not, apparently, greatly affect the quality of the filtrate. Laboratory results indicate only slightly increased defecation due to the use of small amounts of lime. However, the use of lime would be advantageous should it prove necessary to guard against the possibility of inversion during the filtration of the juice.

Filtration of Raw Beet Diffusion Juice.

Simulation of factory conditions.—The experiments described in this paper cover in all 56 filtration tests. Nearly all of them were made with a small filtering area; and, owing to the wide variation in the quality of the juice coming from the battery, most of the tests were made on split samples of juice taken from only one measuring tank in order to make them as nearly comparative as possible.

In order, therefore, to simulate factory conditions to a greater degree a number of tests were made in which the entire filtering area of the press, 4·5 sq. ft. was used, under which condition it was possible to obtain samples of raw diffusion juice from 12 to 15 different measuring tanks to filter it all in one run. A good idea of the quantities of juice filtered and the rates of flow secured is given in the following tabulation, showing quantities of juice and rate of flows. "Hyflo Super-cel" was added in each case.

TABLE IV.

Test	Per cent Filter-aid on Juice	Maximum pressure, lbs.	Average temperature °C.	Total gallons filtered	Total Filtering time, hrs.	mins	Filtration Rate. Galls. per sq. ft per hour
D 3	0·25	26	60	240·3	3	10	16·7
D 4	0·20	50	55	144·0	2	37	12·2
D 7	0·20	40	55	191·2	2	34	16·6
D 8	0·19	44	50	166·9	2	56	12·6
D 9	0·19	42	50	181·4	3	26	11·7
D 10	0·11	41	49	91·2	1	36·5	12·5
G 9*	0·25	38	80	158·2	2	31	14·0

In most of these tests the filtration was started at whatever temperature the juice happened to be in the measuring tank. However, filtration took place so rapidly that the heating coils in the tanks used with the experimental filter were inadequate to heat the juice as fast as it was filtered, the average temperature being therefore much lower than the temperature of the juice in the measuring tanks.

After filtration the raw juice was brilliantly clear, due to the removal of beet pulp, fibre, and matter coagulable at the temperature of filtration. The filter cakes consisted of about 25 per cent. by weight of pulp and slimes, showing the great amount of suspended matter removed by the microscopic screening action of the "Hyflo Super-cel," and they were easily washed free from sugar in the filter-press.

Effect of filtration on impurities.—In each filtration test, composite samples of the unfiltered and of the filtered juice were taken for analysis. These samples were given a first carbonatation and filtration, and a second carbonatation and filtration in the laboratory. The samples thus treated were then evaporated to thick-juice density and again filtered. These thin-juice and thick-juice samples were analysed, a representative filtration test (D 9) giving figures as follows (per 100 of dry substance):—

TABLE V.

	Polarization.	Total Non-sugars	Ash.	Organic Non-sugars.
Diffusion juice, *not* filtered	86·41	13·59	4·43	9·16
Diffusion juice, *filtered*	87·15	12·85	4·19	8·66
Thin-juice, from *unfiltered* raw juice.	89·80	10·20	3·49	6·71
Thin-juice, from *filtered* raw juice	90·39	9·61	3·12	6·49
Thick-juice, from *unfiltered* raw juice.	90·00	10·00	3·35	6·65
Thick-juice, from *filtered* raw juice	90·88	9·12	3·01	6·11

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* *pH* 7·0.

Calculating from the above table, the thick-juice from *unfiltered* diffusion juice is shown to have 27·4 per cent. lower organic non-sugar content than the original unfiltered diffusion juice. But the thick-juice from *filtered* diffusion juice had an elimination of 33·3 per cent. of the original non-sugars. The additional elimination of non-sugars accomplished by the "Super-cel" filtration was therefore in this instance 5·9 per cent. of the non-sugars originally present in the juice.

Conclusions.—Filtration of raw diffusion juice is readily accomplished with economical rates of flow by using "Hyflo Super-cel" in quantities varying from 3·0 to 6·0 lbs. per ton of beets, depending upon the quality of the juice. Any of the standard types of pressure filters are suitable for this filtration.

Assuming an average rate of flow, during a three-hour filtration period of 13 galls. per hour per sq. ft., the press equipment required to handle the juice from 1000 tons of beet every 24 hours will be approximately 1200 sq. ft. of filtering area in continuous operation. This is equivalent to three 600 sq. ft. on plate-and-frame presses operating on three-hour cycles; or 1200 sq. ft. of filter area on filters of the Sweetland or Vallez type. Filtration rates are greater at the higher temperatures.

Liming to neutrality to brom-thymol-blue, corresponding to a *pH* value of 7·0, results in a small decrease in filtration rate; but, by neutralizing the natural acidity of the juice, it prevents any possibility of inversion. Laboratory data also indicated decided reduction in the organic non-sugars, ash, and coagulable matter as the result of the filtration of the raw juice with "Hyflo Super-cel."

Recent Work in Cane Agriculture.

TOLERANCE AND RESISTANCE TO THE SUGAR CANE MOSAIC. *Edgerton and Taggart. Journal of Agricultural Research, Vol. XXIX, No. 10. November, 1924.*

This paper should be read carefully in order to gauge its exact meaning, or the claims of the authors may be liable to misconstruction. They consider that it is possible that resistant strains are developing in nature, and thus in time the low-yielding, highly susceptible plants will be eliminated, and that there is some evidence that this may be taking place in some sections of Louisiana where the oldest mosaic infections occur. Although it might be thought that the attempt was made to increase tolerance and resistance by a process of selection, the authors do not lay claim to any such desirable result. They do, however, claim that in the two varieties tested, D 74 and Purple, "plants have been selected in fields with 100 per cent. infection which show a marked tolerance to mosaic." This, however, implies that in a cane variety grown on a commercial scale there may be strains present which are more tolerant than the rest. Whether this conclusion is borne out by the experiments is somewhat doubtful, as details of the environment are not given, and no reference is made to the length of time during which the different plants have been attacked. The period of trial (three years) seems to be somewhat short for permanent results to have been obtained.

The authors point out that in plants propagated vegetatively the only hope of dealing with mosaic is the creation of a supply of healthy seed. This, however, they declare to be impossible in Louisiana because from 3 to 5 tons of seed cane are required to plant up one acre; and furthermore that there is no room for nurseries, and roguing has proved a failure. The spread of the disease is extremely rapid, much more so than had been anticipated and, once the disease appears in a field, it has quickly reached 100 per cent. infection. In Java where mosaic has been present for many years, tolerant varieties have been found, and occasionally in other countries varieties are met with, either immune or with marked resistance; possibly the Toledo cane reported in 1923 from the Philippines may be one example of this. On testing, the commercial varieties grown in Louisiana, D 74, D 95, Purple and Striped, were found to be highly susceptible, and healthy plants introduced to 100 per cent. infested fields also became so at the end of the first season. A table gives details of the rate and increase of infection in D 74, D 95, Palfrey,[1] and Striped during 1920-1922; in the two latter years, while the infection in May was 0·0 to 4·4, it had reached 100 per cent. by September in all three years (the May counts having been lost in a fire in the first year).

Considering these facts, the prospect in Louisiana is not hopeful; gradual deterioration of the cane is to be expected, with an ultimate failure of the crop, unless an immune variety can be found. It has been noted, however, that L 511, a seedling which is rich in sucrose but too light in growth for general cultivation, is much more slowly infected than the standard kinds. This variety reveals the disease on the stem as well as the leaves, in that the stalks of attacked plants show red lines on the light-green background. For years stalks with no red lines have been selected and planted. The results as to the rate of spread of the disease are shown in a table in which the infection in May is given as ranging from 2 to 14 per cent., while in October it was only 23 to 43; presumably these selected plants were treated as in the standard varieties and planted in a 100 per cent. infected field, but this is not stated.

Selecting for mosaic tolerance.—This is described as an attempt to obtain more resistant or tolerant strains of the commercial varieties. In a plant propagated vegetatively there appear to be two possibilities worth testing: (1) Will sugar cane varieties which show moderate susceptibility or tolerance to mosaic vary enough (perhaps by bud variation) to produce some plants or strains which will become more tolerant than the rest? And (2) will a plant affected by mosaic, if propagated for a number of years, gradually acquire more resistance to or immunity from the disease? Then follows the sentence: "The acquiring of immunity is a common thing in human and animal diseases, but no example of a plant acting in a similar manner has been demonstrated." This dictum can hardly apply to (2) with asexual "propagation for a number of years," or indeed, to (1): whereas, if succeeding generations are being referred to, i.e., by *seed*, the statement is somewhat misleading.

Experiments to test these two possibilities were commenced in the fall of 1920 in fields of D 74 and Purple in a region that had for several years shown a 100 per cent. infection, and were maintained for the two following years. Stools showing "least injury from mosaic" were chosen for planting, and this was judged by the number and size of the mosaic markings; but cane showing total freedom was rejected. The selected canes were planted side by side in a field of maximum infection; and this process was repeated each year. The result is shown in two tables, one for each variety; and, as might be expected, while in May the percentage of infection was lower in the selected than in the unselected plants, by the end of the season all appear to have been invaded by the disease. But the distinctness of the markings is much less in the selected canes, so that at the end of the experiment it became almost impossible to be certain that they were infected. Crop yields were taken at the end of the last two years and were favourable to the selected material. The yields in these two years differed a good deal in all cases, presumably for climatic reasons, but it must be noted that the proportion which the crop of the unselected bore to that of the selected did not vary materially: in one cane it became slightly less, but in the other it became slightly greater. When viewed from a short distance, the difference in the appearance of the selected from the unselected was, according to the authors, much more striking than the difference shown in the two tables. The authors conclude their argument as follows:—"If resistant strains are developing in nature, ... by discarding the susceptible and selecting only the most tolerant canes for seed, it is possible that our present varieties can be developed to a tolerant condition in a much shorter space of time than if natural selection is allowed to take its course." But this, as already pointed out, is not what they claim to have achieved.

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[1] According to EARLE, Palfrey = John Diamond, 1888 = Crystalina.

DISEASES OF SUGAR CANE OF THE MOSAIC TYPE IN SOUTH AFRICA. Part I. The Mosaic, Mottling, of Yellow Stripe Disease. *H. H. Storey. Reprinted from the Journal of the Department of Agriculture. August, 1924.*

This disease, first reported from Java in the eighties, but overshadowed by sereh, has spread to practically all the more important sugar cane tracts, Mauritius alone being free from it. A severe crisis occurred in Porto Rico in 1919, and possibly Cuba will follow in a few years. It was found in Natal by the author when he arrived in 1922, and there was no previous authentic record. There is no known causative agent, therefore diagnosis depends on the symptoms, namely, areas of pale green on the leaves of a distinct pattern, although this latter varies in different cane varieties. There is a general tendency for the markings to become elongated, but they spread irregularly and are best described as blotches. Normally they are present on the whole of every leaf, but as these become old they tend to be more or less obscured; therefore, the determining point is their presence on the young leaves as they unfold, thus ruling out most other types of markings. In some cases the stems are also marked, for instance, red coloured canes show lighter blotches, together with shrinking and sometimes cankers due to dying tissues; conversely, pale canes are reported to develop deeply pigmented areas. Susceptibility varies greatly with different kinds of cane, and it is important to distinguish between tolerance and immunity. Tolerant varieties are the Java Chunnee × Cheribon crosses, and in Natal Agaul, which is only to be distinguished from Uba by this character; immune, Uba, Kavangire, Japanese, etc., possibly synonymous terms applied to the same cane. Losses are patent in all thick varieties, where the affected canes become shorter and thinner. Experiments in Hawaii and Trinidad suggest losses varying from 3 to 50 per cent. BRANDES in 1919 noted that ten estates in the worst affected area of Porto Rico showed a falling-off in crops on an average of 40 per cent., while ten in the mosaic free tract reported a slight increase. STEVENSON estimated that up to 1919 the loss due to mosaic in the island had reached a total of 3½ million dollars. In Argentina the industry was saved through the chance introduction of the tolerant Java seedlings mentioned above, and although permeated by mosaic the yield has been maintained; it would probably have been increased if the disease were absent.

Sets from affected plants invariably produce diseased plants, and no manuring or other treatment will avert this. Greater yields are, however, obtained by increased care in cultivation, but, of course, this is also so with healthy plants. True seed is incapable of carrying the disease, a fact of great advantage to annuals, as every crop starts healthy; but in these crops epidemic outbursts are frequent, therefore secondary infection must be present. Ample evidence is available that an insect vector is responsible for this, and this has proved to be *Aphis maidis*, an insect common on maize, Sorghum and wild grasses, but very rarely found on sugar cane. Secondary infection, however, also occurs on sugar cane, and this has been observed to increase after weeding, as observed by CHARDON and VEVE in Porto Rico, and no infection occurred when aphids were excluded; KUNKEL in Hawaii also observed rapid spread after weeding. But this hypothesis does not explain all the phenomena.

Control factors must consider the presence of a source of infection and the presence of suitable aphids to carry the disease to the cane plants. In the absence of either of these mosaic will not appear in healthy crops or spread in those partly infected. As to Natal, the author considers it probable that mosaic was introduced from the Argentine with an importation of tolerant Java seedlings in 1914, and that the supplanting of the thick kinds grown by Uba some 30 years ago was not rendered necessary by the presence of mosaic in these kinds. All the Argentine canes in Natal appear to be 100 per cent. infected, while there is evidence of a rapid spread now taking place in the scattered plots of thick canes, so that these are about half diseased. Uba takes up about 99·8 per cent. of the cane area; other varieties are found on 300 acres on European estates and about 50 acres among 500 Indian cultivators. STOREY advocates the complete eradication of all but Uba as the basis of control measures. This may be of no appreciable importance while Uba is the only commercial variety grown, but there are indications that better milling varieties would be welcomed in Natal and these would probably not be immune to mosaic. Uba is quite susceptible to red rot, smut and probably other diseases and there is always a danger in a one-crop area, but the number of tolerant and immune varieties is too few. Probably the varieties suited to the fertile flats of Zululand would be neither tolerant of nor immune to mosaic. Doubts have been expressed as to the efficacy of this seemingly drastic measure (of eradicating all non-Uba varieties), because, for instance, of the possibility of the disease harbouring in wild grasses, etc.; and the matter was accordingly referred to BRANDES and EARLE. Both of these authorities held the view that no damage from this source was to be feared. The reprint is illustrated by coloured plates of leaves and stems affected by mosaic, and while both are very well done, the latter is likely to be of special use in the delineation of canker.

C. A. B.

The Irish Free State Government have decided to accept the offer of a Belgian syndicate to establish a sugar beet factory in the Free State.

The control of the administration and the management of the Imperial Institute has under a new Act of Parliament been transferred from the Colonial Office to the Department of Overseas Trade, the Parliamentary Secretary of which will henceforth be responsible.

The International Sugar and Alcohol Co., Ltd., propose to establish, in conjunction with the Plane Creek Central Sugar Mill authorities, a factory at Sarina for the production of power alcohol. It is intended to treat the supply of molasses from the mill for the manufacture of power alcohol, and as a further source of raw material, it is proposed to plant 300 acres with cassava. It is estimated that the yield of cassava would be from 8 to 12 tons per acre, and that one ton of cassava would produce 39 gallons of power alcohol. On the other hand, one ton of sugar cane would produce 20¼ gallons of power alcohol, but the former crop might be grown more cheaply than sugar cane. The estimated consumption of petrol for power alcohol purposes in the Commonwealth is 42 million gallons yearly, and it was estimated that 65 million gallons would be required for next year, indicating the very rapid rate at which power alcohol requirements were increasing. The entire molasses yield from the 1925-26 crop would produce not more than 7,200,000 gallons of alcohol, or about 17 per cent. of the present total requirements. The Australian Government will assist the scheme by advancing £250,000 to the Plane Creek Central Mill by way of a loan.

Hawaiian Factory Results, 1924 Season.[1]

By E. T. WESTLY.

Nineteen hundred and twenty-four witnessed the biggest crop ever harvested in Hawaii. The figures referred to in the following article represent the averages from 40 factories.

VARIETIES OF CANE MILLED.

For many years Yellow Caledonia ranked first in tonnage of the different varieties milled, but now H 109 has taken the lead, 38·1 per cent. of the 1924 crop being from this variety. Yellow Caledonia was second with 32·6 per cent.; D 1135 third with 12·0 per cent.; and Lahaina, once the leading cane in Hawaii, fourth with 4·4 per cent.

H 109 has come to the front by leaps and bounds, and Lahaina has gone out as fast as H 109 has increased,; Yellow Caledonia is decreasing slowly, and D 1135 is just about standing still.

QUALITY OF CANE MILLED.

One has to go back to 1920 to find a higher per cent. polarization of cane, and all the way back to 1917 to find an average first expressed juice purity as high as the average for 1924. The per cent. polarization was 13 26 and 12·78 in 1924 and 1923. Average purity of first expressed juice was 87·86 and 87·05; average fibre of 12·74 and 12 82. The quality of the cane in 1924 calls for 1 ton of sugar from 0·32 ton less cane than did the 1923 quality of cane. The actual reduction was 0·30, but it should be borne in mind that in 1924 the sugar polarized 0·28 higher than in the previous year.

MILLING RESULTS.

Average tons (2000 lbs.) cane per hour for 1924 were 43·63 against 42·03 in 1923, a speeding up. Tons pressure per linear foot of roller, 66·9 against 66·2. Water added to the mills has decreased slightly from 35·12 in 1923 to 34·90 per cent. cane in 1924.

Comparing the milling loss (that is, sugar lost in bagasse per 100 of fibre in bagasse), we find it to be 2·78 in 1924 against 2·76 for 1923. On the other hand, the extraction ratio (ratio of per cent. unextracted sucrose to fibre in cane) decreased from 0·22 to 0·21. Polarization in bagasse was 1·56 during 1924, 0·01 higher than the 1923 average. The per cent. moisture in the bagasse was also practically the same: 41·58 against 41·56 for 1923.

From these bagasse figures one would expect a slightly lower extraction in 1924 than in 1923, but due to the higher polarization and lower per cent. fibre in cane the average extraction reported for 1924 is 0·10 higher or 97·33 against 97·23, the average of 1923. No new records in extraction were established during 1924 by any factory. Seven averaged under 2·0 milling loss in 1924 against five in 1923. Over 98 extraction was reported by nine for 1924, but in 1923 only five went over this mark. Out of the nine factories reporting over 98 extraction three were 9-roller mills equipped with 3-roller crushers. That holding second place with an average extraction of 98·87 was a 3-roller crusher and 9-roller mill, so the modern 3-roller crusher is undoubtedly a very efficient piece of machinery when it comes to getting high extraction.

The average milling work cannot be improved upon to any great extent in Hawaii. An average extraction per cent. sucrose of 97·33 for 40 factories is no doubt a record far ahead of any other country.

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[1] *Sugar News*, 1925, 6, No. 5, 260-262; see also *I.S.J.*, 1924, 431.

Hawaiian Factory Results, 1924 Season.

BOILING-HOUSE WORK.

Clarification.—The average figure for lime used during 1924 was 0·086 per cent. on cane, against 0·087 per cent. reported for 1923, while 1·46 was the increase in purity from mixed juice to syrup for 1924. This is 0·07 less than the 1·53 increase for 1923. That the clarification was not quite as good in 1924 as in the previous year is no doubt due to the increased rate of milling which automatically reduced the settling and mud press capacities, and consequently also reduced the amount of lime used. Investigations in Hawaii have shown rather conclusively that to obtain a good clarification it is necessary to lime to a higher alkalinity than was considered necessary formerly, this causing the former standards for settling tanks and mud press capacities to be too low.

Filter-presses.—Polarization in mud averaged 2·26, slightly less than during 1923, when the average was 2·31. Quantity of press cake was also less, being 2·16 per 100 cane in 1924 and 2·22 in 1923.

Evaporation.—A syrup Brix of 63·32 was obtained for 1924, practically the same as in 1923, when the average was 63·26.

Commercial sugar.—Polarization of the sugar is now over 97. This increase is the result of efforts along the lines of producing a better refining sugar. Average for 1924 was 97·18 polarization, 0·28 higher than for 1923. That Hawaii tries to ship as little water as possible, and also tries to turn out a good keeping sugar, is shown by the average per cent. moisture of 0·75 for 1924. In 1923 the average was 0·83.

Low-grade work.—The average gravity purity for final molasses was 38·16 for 1924 or 0·26 higher than the 37·90 average for 1923. But due to higher juice purities the loss of sucrose in molasses was less in 1924 than during 1923. Loss of sucrose in molasses per cent. polarization of cane was 7·41 in 1924 and 7·58 in 1923. This brings out very strongly the importance of high juice purities.

One factory established a new record in low molasses purity during 1924 by averaging 33·09 for the season. The previous low figure of 33·16 was held by the same factory.

Undetermined losses.—These have increased from 0·48 polarization per 100 polarization in cane in 1923 to 0·61 in 1924.

SUMMARY OF RESULTS.

The average factory work in 1924 compares fairly closely with the work done during 1923, although that in 1924 was not quite so good. But due to the better quality of cane milled and higher juice purities, we find that the overall recovery was higher in 1924 than it was in 1923. Total recovery per cent. polarization of cane was 88·94 in 1924 or 0·17 higher than the 88·77 obtained in 1923. But if the work had been as efficient as the work in 1923 the overall recovery due to the better juices should have been 89·26 or 0·49 higher than it was in 1923. This again brings out strongly the great importance of higher juice purities.

The figures on page 488 show that the rate of milling in the Philippines is much faster than in Hawaii; and that the per cent. polarization in cane is higher in the Philippines with considerably less fibre in the cane. In Hawaii there were much better juice purities, but due to the much higher extraction the drop from first expressed juice to mixed juice was 0·35 greater than in the Philippines, and the increase from mixed juice to syrup was 0·30 less in Hawaii than in the Philippines. This, in the writer's opinion, goes to prove it is not "all velvet" with high extraction. Very much higher dilution is used in Hawaii, which together with the slow rate of milling accounts for the very much better bagasse and extraction figures obtained in Hawaii. The loss in mud press is less in

Hawaii, and losses in molasses also slightly less in Hawaii; but, due to a higher undetermined loss in that country, the total boiling-house losses are 0·02 less in the Philippines than they are in Hawaii.

1924 AVERAGES FOR T.H. AND P.I.

	Hawaii, 1924	Philippines, 1924
Number of factories	40 0	16·0
Tons cane per hour	39·58	54 22
Tonnage ratio	1·48	1 82
Cane—		
Per cent polarization	13·26	13·45
Per cent. fibre	12·74	11·43
Juices—		
Purity first expressed juice	87 86	85 64
Purity mixed juice	85 05	83·18
Purity last mill juice	71·62	75·08
Purity syrup	86·32	84·75
Drop from first to mixed juice	2·81	2 46
Drop from first to last mill juice	16 24	10·56
Drop from first to syrup	1·54	0 89
Increase from mixed juice to syrup	1 27	1 57
Java ratio	81·6	81 8
Bagasse—		
Per cent polarization	1·56	3 39
Per cent. moisture	41·58	47·40
Dilution, per cent normal juice	34 90	13·97
Extraction—		
Per cent. polarization in cane	97 33	94·04
Milling loss	2·78	7 05
Extraction ratio	0 21	0 52
Mud Press Cake—		
Per cent polarization	2 26	3·71
Weight on cane	2 16	1·87
Sugar—		
Polarization	97 18	96·39
Per cent moisture	0 75	0 93
Waste Molasses—		
Gravity purity	38 16	38·44
Losses per 100 Polarization in Cane—		
Bagasse	2 67	5·96
Mud	0·37	0 45
Molasses	7·41	7 52
Undetermined	0·61	0 40
Lost at mill	2 67	5 96
Lost in boiling-house	8·39	8 37
Other Data—		
Tons cane per ton sugar	8·26	8·36
Quality ratio[1]	8·25	8·31

In Hawaii they actually used 8 26 tons of cane to produce 1 ton of 97 18 polarization sugar, whereas the Philippine quality ratio called for 8·31 tons of cane per ton of sugar, 8 36 being actually used to produce 1 ton of 96·39 polarization sugar. Allowing for the difference in polarization in the Philippines, 0 11 ton more cane was used to make a ton of sugar than should have been used in the P.I had we been as efficient in regard to recovery.

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[1] Hawaiian method of figuring quality ratio used in both columns

Plantation Railways and Equipment.

By E W. FAHLGREN.[1]

The railway system of a plantation, which uses this means of transportation, is one of its most important units, although in many cases it does not get the same careful consideration and attention as do other units of equal or lesser importance. A fine, big, up-to-date and highly efficient crushing plant and boiling house, with tons upon tons of the finest cane grown, is of little use without adequate means of transporting the cane to the mill and the raw sugar from it.

Railway transportation is unquestionably the most efficient means now in use for transporting heavy loads of any kind. It has numerous advantages, chief of which are reliability, standardization of equipment and component parts, and comparative ease in training men to operate. There are also some disadvantages, the two main ones being the difficulty of surmounting steep grades and negotiating sharp curves.

The work of locating railway lines gives many opportunities for engineering ability of the highest order. The locating engineer should first ascertain the amount of money available for construction purposes, the probable amount of traffic, general nature of rolling stock to be used, approximate amount of mileage that will be required, including mill yards, branches, and sidings, and the gauge of track. The gauge of track plays an important part in the locating of lines and should be given considerable thought.

In selecting a track gauge, first consideration should be given to the gauge of any already established commercial railway which would act both as a feeder for incoming supplies and as an outlet for sending raw sugar to the port of shipment. If there is no such railway, then consideration should be given to the gauge of other plantations in the vicinity, as inter-connecting railway lines are sometimes very useful. Care should be taken in such cases, however, as the gauge may be one that is too narrow for efficient operation of rolling stock.

The standard gauge of the United States is 4 ft. 8½ in., and plantation gauges run from this down to 20 ins. Plantations in Cuba use the 4 ft. 8½ in. gauge, as they operate cane cars of 30 and 40 tons capacity with eight wheels under them, the small 5-ton 4-wheel car being almost unknown. In the Philippines two gauges only are used, 3 ft. and 3 ft. 6 in.; only one Central has a smaller gauge. Brazil uses mostly the metre gauge, 39⅜ ins. In Hawaii we have 4 ft. 8½ ins., 3 ft., 2 ft. 6 in., and 2 ft. The 3 ft. gauge predominates on most of the plantations, and this gauge has become known as "the standard narrow gauge" among manufacturers of narrow gauge equipment.

CARL B. ANDREWS, in his article on "Transportation" in the *Planters' Record* of 1918, gives the advantages of narrow gauge railways over the standard gauge as follows:

1. Lower original cost, because of the smaller dimensions of rolling stock, requiring narrower cuts and fills and light track, and, because of the possibility of using sharper curves, the ability to fit the line to the terrain closely.

2. Because of the possibility of sharp curves, it is easier to take the track into close quarters near mills, etc.

Among the disadvantages he mentions:—

1. The impossibility of changing the gauge to standard after a narrow gauge has been once adopted, without great cost.

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[1] A Paper presented at Third Annual Meeting of Association of Hawaiian Sugar Technologists, Honolulu, October 27th, 1924. (Here abridged).

2. Delay in obtaining from manufacturers of rolling stock, material, locomotives, or cars which differ from the accepted standard.

3. Limitation of carrying capacity because of small locomotives and cars.

The writer agrees with Mr. ANDREWS in his statement of the advantages of the narrow gauge, but does not agree on all his disadvantages under present manufacturing conditions. The first-mentioned disadvantage is, of course, a real one, but it need hardly be considered, for, after a plantation has once adopted a gauge, say of 2 ft. 6 in. or 3 ft., there is hardly any likelihood of their changing it to the standard gauge of 4 ft. 8½ in.

The second disadvantage does not apply to-day, as there are any number of reliable manufacturers of locomotives and cars who specialize in narrow gauge equipment. Some of them carry large stocks of narrow gauge equipment in the various sugar-growing countries. There is a delay in manufacturing some items of narrow gauge equipment, but this applies as well to standard gauge or any other accepted standard, for no manufacturer keeps locomotives and cars on hand ready to be shipped at a moment's notice, unless it is second-hand equipment.

The third disadvantage still exists but is practically negligible, for none of our local plantations are handicapped by inability to haul their cane to the mill on account of the narrow gauge. If they are handicapped at all, it is through lack of necessary equipment for hauling.

After the above digression we can get back to the subject of locating the railway lines. The locating engineer, having all the foregoing information in his possession, is now in a position to begin his surveys. He should first carefully look over the country surrounding the plantation and ascertain roughly where the railway lines will have to run, ever keeping in mind the necessity of obtaining as low grades as possible, even adding a reasonable distance to his line to accomplish this. After doing this, he should start his actual surveys, commencing at the mill site, or from a point where the mill yards will commence. When the line is once permanently located, cross-section work should start so that grading may begin.

Embankments should be made wherever possible with a width of 12 ft. on top, so that there may be 3 ft. clear on each side of track outside of sleepers. This provides a space for unloading ballast without waste, gives room to walk alongside of a loaded train, and often saves bad wrecks by preventing derailed cars from rolling down an embankment.

Cuttings should be laid out to give at least 14 ft. width at the bottom, so that a 2-ft. ditch can be made on each side to drain water from the cut.

Drainage is an important factor to consider. Openings provided with ditches leading to them should be put through the grade at all places where water is likely to accumulate and damage the track. If a culvert is to handle this, it should be put in while the grading is being done. Culverts may be of square concrete, concrete pipe, or corrugated galvanized iron pipe. A concrete head should be put on to keep the water from washing around the pipe.

Bridges should be of ample length to take care of flood-waters. Short spans can be built up very cheaply by using concrete piers and standard I beams. Wide spans, from 20 ft. up, should have steel girders or truss constructions with concrete piers or abutments. Hard wood may be used in bridge construction, but steel will be cheaper in the end if given proper attention.

Crushed rock makes the best material for ballasting, although sometimes it is possible to obtain river gravel mixed with sand, which makes a very good ballasting material.

As curves are one of the chief factors in limiting the tonnage hauled over a railway, it is well to give them careful thought. Due to the many factors involved, it is impossible to give an exact rule for computing the resistance due to curves of any given radius. It is generally considered, however, that the resistance amounts to from 0·7 lb. to 1 lb. per ton per degree of curvature, the lower figure being used for large capacity cars and the higher figure for smaller capacity cars, as in the latter case there are more wheels and axles per ton of weight than in the former. The sharpest curve to which two pairs of flanged wheels will adjust themselves depends upon their distance apart, the diameter of the wheels, and the size and shape of the flanges.

Taking the Master Car Builders' standard for flanges and rails and assuming that the gauge is not widened on the curves, a sufficiently accurate formula for all practical purposes is as follows:—

$$R \quad \frac{W}{2 \sin a} \quad \text{in which}$$

R = radius of the sharpest curve that can be passed,
W = wheelbase of car or locomotive,
a = angle the flanged wheels make with the rails.

The minimum radius advisable for plantation use may be taken as about 175 to 210 ft., although in a great many cases a smaller radius has to be used.

The outer rail on all curves should be elevated, and the amount of this elevation may be determined from the following formula, presented at the annual meeting of the American Railway Engineering and Maintenance of Way Association in 1905:—

$$E = 0{\cdot}00066\,DV^2,$$

where E = elevation of outer rail in inches,
D = degree of curve,
V = velocity of train in miles per hour

Since the elevation required is a function of, and depends upon, the train speed, this speed is the first element to be determined. Ordinarily an elevation of 8 ins. is not exceeded, and the speed of trains should be regulated to conform to that elevation.

At the 1919 convention of the American Railway Master Mechanics' Association, the committee on widening gauge of track at curves recommended as follows:—

> Curves of 8 degrees and under should not have the gauge widened. Gauges should be widened ⅛ in. for each two degrees or fraction thereof over 8 degrees to a maximum of ¾ in. Gauge, including widening due to wear, should never exceed 1 in.

Gradient is the other chief factor that controls the tonnage that can be moved by a given power over the railway. The maximum gradient must not exceed that up which the power to be used may haul the desired load to be taken up; also it must not be so great that the braking power used will be insufficient to stop any down-coming train within a reasonable distance should necessity require.

When a train is hauled up a gradient, the resistance due to friction is increased by that due to lifting the train against gravity. The amount of this increased resistance is determined as follows:—One mile equals 5280 ft., and, if the gradient be 1 ft. per mile, the pull necessary to lift a ton of 2000 lbs. will be $2000/5280 = 0{\cdot}3788$ lbs. per ton of 2000 lbs.; the rise in feet per mile must be multiplied by 0·3788.

If the gradient is expressed in feet per hundred or per cent., the resistance in lbs. per ton of 2000 lbs. will be $2000/100 = 20$ lbs. for each per cent. of gradient.

To resistance so obtained must be added that due to speed and internal friction in order to find the total resistance in lbs. per ton. In the cases of standard railroad cars and the average plantation car using brass or bronze bearings, the frictional resistance can be safely figured at 10 lbs. per ton of load.

Until just recently too little attention has been paid to the size and weight of rail used for track. Of course, when the majority of our plantations were started, years ago, their locomotives were much smaller and lighter than those of to-day. Considerable money could have been saved, however, by originally laying heavier iron rails, which were easily and cheaply obtainable in those days.

The average steam locomotive for plantation use to-day weighs from 15 to 20 tons, and for such locomotives nothing less than a 35 lb. rail should be used. 40 or 45 lb. rails would be preferable, as these weights would better bridge over a rotten or broken sleeper and stand up over soft places without kinking.

In the purchasing of light steel rails, there are three kinds to be considered. By light rails is meant those weighing 60 lbs. per yd. or less. The differences are as follows:—1, "Billet-rolled" rails; 2, "re-rolled" rails; 3, "re-laying" rails. "Billet-rolled" light steel rails are for the most part rolled from offheats or discards, or from steel which proved inferior for the purpose for which it was intended. Rails rolled under the "re-rolling" process are manufactured from steel made expressly for rail purposes which has stood the full test required in such use. "Re-laying" rails are second-hand rails which have been used and then taken out of service for any number of reasons. Such rails should never be bought unless an exceptionally favourable price is offered and a rigid inspection made at the time of purchasing. Rails that have been used for some time should be replaced when the splice bars are being chipped by the wheel flanges, when the side of head is worn as much as one-eighth the original width, or when the side of the rail head is worn to the shape of the wheel flange and fillet.

Sleepers should be at least 5 in. × 7 in. × 6 ft., hard wood preferred. Hewn sleepers are always the best if obtainable, as bearing surface is what is wanted, and this is more readily obtained from hewn sleepers. Those measuring 6 in. × 8 in. × 6 ft. are being generally used as a standard size. No uniform rule can be made for the spacing of sleepers owing to the varying elements that govern this, such as sub-grade, depth of ballast, axle loads, etc.; but 2 ft. centre to centre of the sleepers has become somewhat of an accepted standard in tracklaying.

The nail spike is the American standard for fastening the rails to the sleepers, and these should be used four to each rail fastening, or eight spikes to each sleeper. Passing trains produce a movement which gradually loosens the spikes, but this causes no real danger to traffic provided the spikes are re-driven in at regular intervals by the section gang. A test made some years ago by prominent railroad engineers determined that the nail spike was more efficient than the screw spike. But spikes should be driven in straight, since a spike driven with a slant under the rail does not have the holding power of a straight-driven spike.

Frogs should not be put in for branches or sidings when laying track, as this necessitates the cutting of rails later when the turnouts are laid. By using one pattern of standard frog all that is necessary afterwards is to open a joint, throw the rail out, and then place the frog. Thus a standard length of lead rail will always fit, and it will be interchangeable with any switch on the line. If the joint does not fit the engineer's frog point, open the back joint instead of the front one, and then compound the curve to fit the engineer's centres ahead. On sidings it can be moved ahead or back a few feet to suit the joint opened.

Plantation Railways and Equipment.

Particular attention should be given to the power used on plantation railways. Steam locomotives are still the most common source of such power, although motor driven locomotives are coming to the fore and manufacturers are giving considerable attention to this type of locomotive. The hauling capacity of a locomotive depends primarily upon the weight carried on the driving wheels; hence the ideal locomotive in this respect would of course be one having its entire weight, including that of fuel and water, carried on the driving wheels. But for plantation service it is not safe to assume that there is a standard type of locomotive. One of a certain type may give perfect service on one plantation, while on another where the working conditions are different it would be an absolute failure. On the large American railroads there are certain types used for shunting purposes, others for freight, and still others for passenger purposes; but for plantation purposes where the service is all shunting and freight, with varying working conditions, there can be no real standard. Therefore in figuring on a locomotive do not go by what the other fellow has, but let your conditions of service be known to the locomotive manufacturer who will give you a specification that should meet your requirements.

Cane cars as used on plantations are for the most part an entirely different proposition from locomotives, and it is possible and advisable to standardize them. All the manufacturers of narrow gauge railway equipment endeavour to standardize their material, and none of them stock anything special. The majority of the accessories in the make up of a cane car are standard with all manufacturers; and where such is not exactly the case, they at least are interchangeable. When these standard parts are used the plantation does not have delay in getting parts, as these may be purchased from any one of the manufacturers represented.

The use of "side stake" and "side door" cars is about equally divided in Hawaii. The latter in the opinion of many are better adapted for loading than the "stake" cars, as runners may be rested on the top of the door and the loaders drop their bundle of cane into the car from this runner. The side door also acts as a chute into the carrier when the car is being unloaded. The advantage of this type of car is its compactness, as it has no stake pockets or stakes to become loose or get stolen. The stake type of car has its adherents, but they all admit the disadvantage of having the stakes lost or stolen. Such loss runs quite high each year, for it is surprising how quickly nicely-cut stakes can disappear from a car. A minor disadvantage with the side door type is the difficulty in releasing the side doors with the pressure of a load of cane upon them. Several types of door latches to give easy release have been tried out from time to time in Hawaii, but none of them has been a success.

Neither of the two foregoing types of cars, as at present designed, is particularly well adapted for use with loading machines. The bundles of cane as they are dropped into the cars spring the end walls out and in time these break off. But as loading machines are here to stay, the writer can promise some interesting developments in car design and unloading devices in the near future.

The most economical type of car for hauling cane would be the large 30-ton double-truck (bogie) cars as used in Cuba. Six 5-ton cars will carry no more cane than one 30-ton car, but these six cars not only have 50 [? 200] per cent. more axles and journal boxes, but their maintenance is a serious item in operation costs. But the larger car could not be operated on portable track, and as most of the Hawaiian cane is transported this way, the larger car is out of question for general use in Hawaii.

The all-steel type of construction in small cane cars has never been popular in Hawaii, because these cannot stand being wrecked down steep grades, and once bent and twisted cannot be straightened out and salvaged. To-day, however, steel cars are being designed so that they will withstand very severe operation usage; and this type will some day come into its own as the maintenance will be so much less in comparison with wooden construction.

In regard to car couplers, the spring type offers the best field for improvements, as it is generally conceded that this type is the best, in that it is the easiest on cars on account of absorbing all buffing and pulling strains. The majority of these types now have the links and pins fastened in the head, preventing these two parts from getting in with the cane and going through the mill rolls.

Wheels, next to couplers, show a wide variety of designs. In Hawaii the spoke type of wheel has always been the most popular, due no doubt to the ease of braking cars by throwing a stake between the spokes. Cast steel makes the best material for plantation wheels, though one or two plantations are using and getting good results from solid cast-iron wheels having well chilled treads. Most of the damage being done to-day to wheels is from flat spots on their treads, caused by the locking of brakes so that the wheels slide along the rails. Some brakesmen have the idea that the brakes are not holding unless the wheels are sliding, which idea is not only erroneous but disastrous. With flat spots, in the case of wet rails, there is the possibility of cars running away.

Brake shoes have always been made of cast-iron, but cast-steel shoes have been tried on some plantations, and though they are hard on wheels it is claimed that they hold better than do iron ones on very severe grades, and that fewer wrecks have occurred in consequence.

Notes on the Cuban Sugar Crop.

By our Havana Correspondent

The sugar crop of Cuba for the 1924-1925 season is now drawing to a close with an output very much greater than was anticipated, and creating a new record for the country.

The crop season was very favourable for harvesting, and very few interruptions took place due to rains. During the early part of the crop there were strikes at a few factories, but as these strikes were not general, and affected a few factories only, while being of short duration, they had really no influence on the output. Therefore, the very favourable harvesting season, allowing as it did continuous work in field and factory, and the enormous crops of cane grown everywhere, were the factors that went to make the greatest crop on record.

At the time of writing there are ten factories still grinding, and some of them may continue operating for another month. Last year at this time there were only two factories grinding.

According to latest figures, which can be considered quite reliable, there was produced by the 20th of July, the enormous amount of 5,050,000 tons of sugar, which is about 1,000,000 tons more than last year's figures at same date. With the ten factories still operating, those figures will be increased by quite a substantial amount. They show that the increase of production this crop over last year's production is much greater than any increase from one year to another since 1913, when, in that year, the increase was 28·3 per cent. over the previous year's figures.

The following table gives the production of sugar in tons of 2240 lbs. since 1918, and also the increases and decreases from year to year, and the percentage of increase or decrease :

Year	Production in round numbers.	Increase or decrease over previous year.	Increase or decrease, per cent
1918	3,445,000	—	—
1919	3,967,000	+ 522,000	+ 15·1
1920	3,729,000	— 238,000	— 6·3
1921	3,935,000	+ 206,000	+ 5.5
1922	3,996,000	+ 61,000	+ 1·5
1923	3,602,000	— 394,000	— 9·8
1924	4,053,000	+ 451,000	+ 12·5
1925	5,150,000	+ 1,097,000	+ 27·0

This enormous increase of over 1,000,000 tons, coming immediately after a record crop, is a clear demonstration of what Cuba can do under favourable conditions.

The outlook for the coming crop is very favourable so far. Good rains have fallen all over the country; young canes, both plants and ratoons, are growing vigorously and have a very healthy appearance; much new planting has been done, and everything points to another large production.

Increase in factories.—There is under construction a new factory on the south coast, and it will be ready to operate next crop. It is in a good locality, and large areas of cane are being planted to supply it.

Two other factories in the same province are having their capacities doubled, and a third, near Havana, is also being doubled. These are the principal increases being carried out for next crop, but many other factories are installing improvements and additions, so that larger outputs can be made. The sugar industry is, therefore, unmistakably putting itself in a position to still further increase the output, and will do so if the growing weather continues favourable.

The following is the distribution of the 1925 sugar crop.

	Tons.
Shipped to date	3,213,000
Local consumption	65,000
Total shipped and consumption	3,278,000
To ship	1,872,000
	5,150,000

No doubt a very large quantity of the above 1,872,000 tons is already sold for future shipment, but, in any case, there are about 1,000,000 tons to dispose of between now and the next crop.

The shipping of sugar dropped considerably towards the end of June and July, but even then, under normal conditions, the sugars remaining on hand should be all disposed of by the time the new crop commences.

July 25th, 1925.

The British Engineering Standards Association[1] has issued a specification (No. 189 of 1925) dealing with filter frames and plates, prepared as a result of proposals received by the Joint Committee of British Chemical Manufacturers and the British Chemical Plant Manufacturers' Association. This work represents an important piece of simplification, which should lead to economies affecting for good the general condition of the chemical engineering industry.

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[1] Copies of this Specification can be obtained from the B. E. S A., Publications Dept., 28, Victoria Street, London, S W.1 ; Price, 1s. 2d post free.

Publications Received.

Official and Tentative Methods of Analysis of the Association of Official Agricultural Chemists. Compiled by the Committee on Editing Methods of Analysis, R. E. Dolittle, Chairman. Second Edition. (Association of Official Agricultural Chemists, Washington, D.C., U.S.A.). 1925.

We are pleased to notice the second edition of the "Book of Methods" of the A. O. A. C., a very valuable compilation, and a model of its kind. It is the outcome of a most rigorous and painstaking scrutiny of procedure, and almost all the methods described are the result of a considerable amount of research by a body of chemists working in a number of separate sections, each under a "Referee." In order to be adopted as "tentative," a method must be recommended to the Association by its Referee, and such recommendation is made only after the method has undergone a thorough collaboration and critical study. But in order to become "official" a method must be again accepted, probably after further examination. Not only the actual procedure itself is thus investigated, but its description is the work of much revision in order that nothing may be left to chance in the direction of lucidity. Such thoroughness has resulted in a work unique in the literature of analytical chemistry. As we remarked when reviewing the first edition,[1] while being models of conciseness the descriptions of procedure omit no details necessary for the proper carrying out of the determinations, and the individual processes are as nearly "fool proof" as it is possible to make them. As to the range of the book, this hardly can be considered to be confined to agricultural work, going somewhat beyond this but "Sugars and Sugar Products," "Fertilizers," "Soils," "Plants," and "Distilled Liquors" are the sections that should be found of especial value by chemists in our industry. Great credit is due to all concerned in the evolution of such a collection of analytical methods.

Distillation Principles. C. Elliott. The Chemical Engineering Library. (Ernest Benn, Ltd., London). 1925. Price: 6s., nett.

Distillation and rectification are considered from the theoretical standpoint, in particular the phase rule, the most salient principles being presented in concise form. Rosanoff's work is discussed in some detail.

Acid-Resisting Metals. Sidney J. Tungay. The Chemical Engineering Library. (Ernest Benn, Ltd., London). 1925. Price: 6s., nett.

This is a guide to the chemical engineer in the selection of suitable metals for the construction of plant intended to resist the corrosive action of liquids and gases. It is a useful summary of the subject.

Superheat Engineering Data. Anon. Sixth edition, revised. (The Superheat Company, 17, East 42nd Street, New York). 1925.

In this handbook is condensed for ready reference the data most frequently desired by steam-power plant engineers and operators. While dealing more particularly with the generation, use, and advantages of superheated steam, it contains a large amount of readily accessible information on steam and steam economy, and is a compilation of value to all engineers.

Proceedings of the Chemical Engineering Group of the Society of Chemical Industry. Vols. 5 and 6a (1923-1924). (Society of Chemical Industry, Central House, London, E.C. 2). 1925. Price: 10s. 6d.

In Vol. 5 (1923) the papers printed in these Proceedings include one on "Heat Transmission," by Mr. B. HEASTIE, which dealt with the general conditions of heat transfer for chemical plant, and the calculations arising in practice.

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[1] *I.S.J.*, 1923, 210

Publications Received.

In Vol. 6 (1924) the most important papers from our point of view were "Centrifugal Dryers and Separators," by Mr. E. A. ALLIOTT, dealing with constructional details of dryers, principles of self-balancing machines, influence of sundry factors, capacities, labour and output, principle of centrifugal separation, practical separators, sundry data, etc.; and "Activated Carbon" by Mr. V. F. GLOAG, treating of the Bayer process of making decolorizing and gas-adsorbing preparations.

Micro-Organisms and Fermentation. Alfred Jorgensen. Fifth Edition. (Charles Griffin & Co., Ltd., London). 1925. Price: 30s. nett.

The last English edition of this well-known work appeared in 1911, and was a translation of the fifth German edition. A considerable revision has therefore been necessitated to bring the work up to date after such a comparatively considerable period. In the main the arrangement of the book is the same, the division being into . microscopic and physiological examination, biological examination of bacteria, moulds and yeasts and the pure culture of yeast on the large scale. But information relating to the yeasts has been considerably extended, which is what one would expect as the result of the large amount of data which has accumulated during recent years. To those engaged in the tropical alcohol industry, the main interest in this book will be the excellent final chapter on the application of pure yeast in the distillery, on which subject the author is an acknowledged authority.

Zuckerchemie. Dr. Hans Pringsheim. (Akademische Verlagsgesellschaft T. B. H., Leipzig). 1925. Price: 18 gold-marks, bound.

It is perhaps strange to state that no treatise devoted to the chemistry of the sugars has appeared in book-form in the German language during the past ten years, and that what information is to be found in the larger treatises on organic chemistry is generally so incomplete that a comprehensive exposition of the principles upon which the subject is based must for some time have been demanded. This want will now be met by Dr. Pringsheim's "Zuckerchemie," which is indeed an excellent compilation. In general it covers much the same ground as our Dr. Armstrong's "The simple Carbohydrates and the Glucosides," dealing with it under the headings of: general characteristics and constitution; oxidation; reduction; condensation; configuration; anhydro sugars; synthesis and degredation of the monosaccharides; biochemical decompositions of the glucosides and their synthesis; disaccharides; and the occurrence, preparation and special properties of the most important sugars. One of the most useful features of the work, especially to the student, is the large number of footnote references to those original papers which have built up our knowledge of the chemistry of the sugars.

Report for 1923-24 of Rothamsted Experimental Station. (Lawes Agricultural Trust, Harpenden, England). 1925. Price: 2s. 6d.

Sir JOHN RUSSELL summarizes as in previous years the considerable amount of work done by the members of the staff at Harpenden, dealing with fertilizer investigations (on grain); green manuring; soil tilth and cultivation; micro-organisms of the soil; insecticides; plant pathology. Nothing is recorded this year on the production of so-called artificial farmyard manure.

Kurzer Historischer Überblick uber den Zuckerrohrbau, Zuckerherstellung und Zuckerchemie in Indien. Syed Ameer Hasan Meerza. (Verlag Lindner & Söhne, Leipzig-A., Germany). 1925.

Brevities.

Production of cane sugar by the electro-osmose process is to be carried out on the experimental scale at the Experiment Station, Government Central Laboratory, Shinka, Tainan Province, Japan.[1]

Société des Etablissements Barbet announce that they are now producing with their new rectifying apparatus, Type E, an alcohol of very good quality at 96–96·5°, starting from musts at 5°, with the consumption of not more than 882 lbs. of steam for 22 Imperial gallons.

The Centrale Suiker Maatschappij of Amstersdam recently floated a public issue of five million Dutch florins which was over-subscribed, and only a portion of the applications could be allotted. It is understood that this money will be used largely to finance new beet sugar schemes in England with which Dutch interests are connected.

The lactone of the raw sugar, galactose, is being used in America as an ingredient of a dental paste ("Lactonique"), having been discovered to disintegrate calcification without in the slightest degree affecting tooth structure.[2] It is not only a effective solvent for calcified pulp, but also for tartar and hard debris in long-neglected tooth cavities, whilst dentist are said to pronounce it the best aid they have yet found in treating pyorrhea.

Dr W. H. DALRYMPLE, for many years Professor of Veterinary Science at Louisiana State University, passed away on July 17th. He was a specialist in livestock sanitation, and his work on this branch had gained him international recognition. He was born in 1866 in Stranraer, Wigtownshire, Scotland, and was a very highly esteemed citizen of Baton Rouge.

BUNSEN, it would appear, did not after all devise the burner with which his name is so well associated. A letter written by the great chemist while Professor at Heidelberg University (and dated May 12th, 1855) to PETER DESAGA, his laboratory mechanician, admitted[3] clearly that the latter had made "a gas burner for heating, which is based upon a principle that I suggested, and which has been constructed in an ingenious form of his own design" And it is certain that the burner referred to here is that universally known as the Bunsen burner.

There are about 300,000 acres of nipa palm in North Borneo, occurring in nearly solid stands of 5000 acres or more. It is estimated that during a year 900,000,000 gallons of sap capable of producing nearly 60,000,000 gallons of alcohol, could be obtained. For a plant capable of producing 2000 gallons per day of 12 hours the capital required is estimated at about £26,000, and the profits on the spirit delivered in Singapore or Hong Kong would be equivalent to a dividend of 10 per cent on the capital. An 8000 gallon plant run for 24 hours per day would require a capital of about £122,000, and this, it is estimated, would yield profits equivalent to 30 per cent. on the capital.

"In the Industrial plant, the operating engineer often feels that the factory management regards the power plant as a necessary evil, something to be put up with for want of a better method of working the wheels in the production department, but something on which no money is to be spent, except in a case of dire necessity. . . . . . The reason for his apparent lack of interest will be clear when we consider that the executive thinks in terms of business and finance, not engineering. . . . . . . The proper stand for the engineer to take is that the question is one of business policy, that, by investing a definite amount of money in equipment carefully selected to decrease the fuel consumption and pay for itself within a definite time, a material reduction can be made in the cost of supplying power. . . . . . . In presenting his case in this way, the engineer will be prepared to prove his point, like any good salesman. For example, if he needs a new feed-water heater . . . . . . he can show how in a definite time, considering past averages, the saving will pay for the heater, and how after that time the power cost will be reduced by just that much, allowing, of course, for the replacing of the heater at the end of its life."[4]

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[1] *Production and Export*, June 1925.

[2] Made by the Special Chemicals Company, Highland Park, Illinois.

[3] The letter referred to here was purchased about two years ago by Cornell University from the grandson of DESAGA. See an article by L. M. DENNIS, *Industrial and Engineering Chemistry*, 1925, 17, No. 6, 651.

[4] W. E. S., in *Power Plant Engineering*, 28, No. 24.

Brevities.

The U.S. Commissioner of Patents reports a speeding up of the work of his office. The average time that a new application must wait to receive official action has been reduced from 5 months to 3, and that in the case of an amended application from 3 to 4 months to 2 to 3 months.

Among new companies recently registered are the following:—St Kitts (London) Sugar Factory, Ltd., of 18, Laurence Pountney Lane, London, E.C. 4. Manufacturers and dealers in sugar, nominal capital, £130,000 in £1 shares. Carbon Products, Ltd., of 3, All Souls Place, Regent Street, W. 1. Manufacturers of, or dealers in, carbon products; nominal capital, £10,000 in £1 shares.

In a new process for the production of liquefied sulphur dioxide from the dilute gases made by burning sulphide ores, the Rhenania Verein Chemischer Fabriken A.-G., of Mannheim, Germany, pass the gases over active carbon. The sulphur dioxide is afterwards liberated in concentrated condition by subjecting the treated carbon to the action of such easily condensible vapours as those of trichlorethylene, chloroform, or alcohol.

Laboratory apparatus firms are offering "an accurately adjusted, extremely sensitive solution" (presumably a "universal indicator solution") for testing the reaction of soils, etc. They claim that by means of it a farmer may know: (1) When a soil needs lime; (2) when a soil contains sufficient lime; (3) after liming, if sufficient lime was applied, (4) the location of spots in fields that may need more lime than other places, and (5) if fertilizers are making the soil acid or alkaline.

The Association of Special Libraries and Information Bureaux has been formed in London,[1] its object being stated to be 'to facilitate the use and co-ordination of all sources of information for scientific, technical, commercial and public purposes." This is to be accomplished (it is explained) by indexing sources of statistical and other data; by co-ordinating abstracting services, by improving the availability and distribution of literature, by registering panels of translators, and by increasing the provision of photographic and other copying apparatus. It is proposed to compile a comprehensive directory of special libraries for the British Isles at once.

In an article on the origin of the Dutch Standard for sugars, W. M. F. Mansvelt recalls[2] that the first range of samples, 20 in number, was used at an auction at Rotterdam in 1839. Its use for establishing a value for samples according to their colour was immediately recognized in Holland and Java, and the Standard came into service in other countries as well. Even at the present time, when the polarization is known everywhere to be a more certain criterion than colour, it is in use in New Zealand, Canada, Japan, and India (in this latter country for imported Javas). But it is steadily losing favour.

At the new Barking (London) electricity generating station the remarkable figure of 88 per cent. steam generation calculated on the nett heating value of the coal (Northumberland slack of 11,000 B. T. U.) with mechanical stoker firing is being obtained, and 92·5 on test trials. Largely owing to the work of the chemist in accurate flue gas analysis, pyrometry, and modern methods of water purification, the performance of large water-tube boilers has been revolutionized within recent years. In the five Babcock & Wilcox and five Yarrow boilers at Barking, the normal evaporation is 68,000 lbs. of water per hour actual at 250°F. with an overload of 50 per cent., the working pressure being 375 lbs. per sq in. with a superheat temperature of 725°F.[3]

Hawaii is planning a survey to determine what new industries might be developed in the islands. Up to the present this territory's industrial efforts have been largely concentrated on the production of sugar and pineapples. Sugar alone makes up normally from 60 to 70 per cent. of the total exports, while with pineapples the two account for from 90 to 95 per cent of the shipments from the islands. The welfare of the community depends therefore almost entirely on these two crops, and it is easy to foresee that either a crop failure or a slump in the world's price of sugar or pineapples would affect the entire community to an abnormal extent. The establishment of any other suitable industries and a diversification of agriculture would do something to increase the stability of the islands' prosperity.[4]

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[1] At 38, Bloomsbury Square, W C. 1.

[2] *De Indische Mercuur*, 48, No. 18, May 1st, 1925.

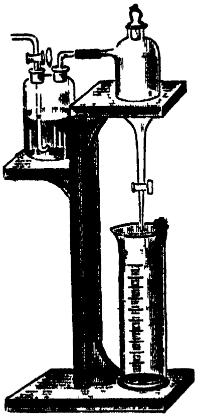
[3] *Chemistry and Industry*, 1925, 44, No. 33,820.

[4] *Commerce Reports*, June, 1925

Review of Current Technical Literature.[1]

Determination of Sulphurous Acid in Sulphur Oven Gases, using Reich's Apparatus. *Communication to this Journal by the makers of the apparatus.*

In sulphitation factories it is very desirable to control, if not regularly, then at fairly frequent intervals, the amount of SO_2 in the sulphur oven fumes, so as to maintain the content at as high and as regular a figure as possible, about 14 per cent. by volume being the figure regarded as an optimum in practice. A rapid and reasonably accurate method for doing this is that devised by Reich[2] and Lunge,[3] in fact this process has been almost universally adopted in the examination of kiln gases in sulphuric acid manufacture Reich's apparatus (see figure) consists of a double-necked absorption bottle having a glass stop-cock in its left-hand tube, which is connected with a tube let into the sulphur oven fume pipe, whilst its right hand one joins the aspirator, which discharges into the cylinder on opening the cock shown. The bottle is half-filled with water, and 10 c c. of N/1 iodine solution are added to it; whilst the aspirator is also filled with water. Before making a determination, the air in the tubes leading to the fume pipe is displaced by the gas to be examined (the apparatus being tight, if, after a short time, the cock between the bottle and the fume pipe being closed, the water ceases entirely to flow from the aspirator). Proceeding to the determination, both stop-cocks are opened, and an amount of water necessary to draw over sufficient gas just to discolour the iodine solution is allowed to run into the cylinder. At this moment the cocks are closed, and the volume of the water which has collected in the cylinder is read. Then if 10 c c. of N/1 iodine was the amount added to the bottle, and W was the c.c. of water collected, the result may be calculated from the formula: $100 \times 11{\cdot}14 / W + 11\ 14 =$ per cent. of SO_2 by volume in the sulphur-oven fumes.



Comparison between a Vacuum and a Pressure Evaporator. *F. Staudinger.* *Sucrerie Belge, 1924, 44, 149; 1924, 44, 241; Vereins-Zeitschrift, 1925, 367-382.*

An ordinary vacuum quadruple with pre-evaporator is compared with a triple effect working "under pressure,"[4] the draw-off being in both cases 106 litres at 16·5° Brix, equivalent to 113 kg. of raw juice, and to 130 kg. of clarified juice at 14·3° Brix, this giving after concentration 30·5 kg. of thick-juice at 60° Brix. Two methods of operating are postulated. In the first live steam is used for heating in diffusion when the total steam consumption for evaporation, diffusion, and power (including losses) is found to be 54 96 kg. per 100 of roots sliced; whereas in the pressure system apparatus 48·20 kg. is the amount calculated to be necessary, leaving a difference of 6·76 kg, which actually should be increased to 7·30, since the heat in the condensed water, which is 6·70 higher than ordinarily, is equal to 0·54, this making a difference of 7·30 corresponding to 9 1 kg. of coal per ton of roots. Using effect vapour for heating in diffusion, the steam consumption in the vacuum system is calculated to be 53·6, and in pressure operation 47·06, a difference of 6·64 kg., that is a coal economy of 8·3 kg. per 100 of roots. It would seem, therefore, that the saving in fuel possible with the pressure system is considerable, being due to several causes, such as the better utilization of the steam and the absence of heat losses in the condenser (this with the attendant vacuum pumps and water pumps being done away with entirely). Admission of steam to the effects is regulated; and altogether the working of the pressure evaporator is easier to supervise. Practice has shown that the colour of the thick-juice is not more than in vacuum work. Moreover, the new system permits the conversion of an old vacuum plant into a triple pressure station by the rearrangement of the vessels to give the desired heating surface which, according to Dr. ULRICH, may be only 35–40 sq. metres per ton of roots sliced per hour. A number of beet houses in Czecho-Slovakia, Austria, Hungary, and Germany (in all 11 last campaign) have gone over to the new system. In the second part of this article the heating surfaces, temperatures, steam consumption, and other data in respect of a pressure evaporator plant are given.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I S.J.*

[2] *I.S J.*, 1914. 390.

[3] Hempell's "Gas Analysis," Chapter 5, on the Gases used in the Manufacture of Sulphuric Acid

[4] *I.S.J.*, 1924, 433; 1925. 53.

REMOVAL OF LIME FROM SUGAR FACTORY AND REFINERY PRODUCTS BY BONECHAR AND VEGETABLE CARBONS. *P. Honig. Chemisch Weekblad, 1925, 22, No. 1122, 165-167.*

Different writers, such as MRASEK,[1] HORNE,[2] and HORTON and SENGSON,[3] have stated that vegetable carbons have the disadvantage as compared with bonechar of removing little lime from sugar syrups, juice and syrups. And the latter two investigators[4] have come to the conclusion that increasing the time of heating also increases the amount of ash adsorbed. In tests undertaken by the present author to examine the point, he found on treating a limed refinery liquor with 1 per cent. of "Norit" at 80 °C. that the lime content (CaO) was 0 039, 0·024 and 0·015 per cent. after one, two and six hours heating respectively. Temperature also was a factor, as on heating for one hour at 70°C. the CaO content was 0·042, and at 90°C. for the same time, 0·021 per cent. But his interpretation of these results is that the removal of lime is a secondary phenomenon resulting from sucrose decomposition, and in order to demonstrate this hypothesis the same limed liquor was heated alone, when after six hours the CaO diminished from 0 042 to 0·018 per cent, the liquor at the end of the time stated being quite dim; whilst in another experiment it was shown that when heating six hours, the CaO content was 0·010 if the "Norit" was added at the end of the test (previous to filtration) and 0·003 if it was in contact with the liquor during the whole of the time. Carbon is believed to act as a catalyst in aiding the decomposition of the sugar, and some carbons are stated to have a more marked effect in this respect than others. His final conclusions are: (1) that in the application of chars to sugar liquors, the lime adsorption is controlled by the duration of the contact, the temperature, and the nature of the adsorbent, and (2) that the principal difference between bonechar and vegetable carbon in respect of lime removal is in the mode of working, so that with decolorizing carbons one can effect the same removal of lime as with bonechar, provided the heating be prolonged for a sufficiently long time to induce the necessary sucrose decomposition.

DETERMINATION OF REDUCING SUGARS IODOMETRICALLY. *Leo Pick. Zeitschrift fur die Zuckerindustrie der Czechoslovakia, 1925, 49, 251-255, 259-263.*

Of the several modifications of the iodometric method of determining reducing sugars, that of SCHAFFER and HARTMANN[5] appears to the author to be the most advantageous, and he now describes the following procedure which he prefers to follow :—25 c.c of blue Fehling's solution, containing 17·32 grms. of cupric sulphate per litre, i.e., about a quarter of the usual concentration; and 25 c.c of white liquor, containing 86·5 grms of pure Rochelle salts and 33 05 grms. of sodium hydroxide per litre (Muller's liquor also diluted four times), are mixed in an Erlenmeyer flask with 50 c.c. of the solution of the sample (containing 10, 5, 2·5, or 1·0 grm. sucrose) and a little talc to promote the regular boiling of the alkaline solution, and obviate the error due to "super-heating." After boiling for 2 mins., 50 c c. of boiled and cooled water are carefully added, the contents of the flask further cooled under the tap, and 20–25 c.c. of a cold saturated solution of oxalic acid run in, after which the iodometric titration is carried out. This is done with a N/63·57 solution (1 c.c. of which is just equivalent to 1 mgrm. of Cu), which is added until a distinct brown coloration results, then a slight excess of N/60 sodium thiosulphate (containing 5 grms of $Na_2S_2O_3$, 5 H_2O in 1 litre) and a few drops of starch solution, after which the iodine is again run in, the addition being continued until the dark-blue coloration persists. Then from the total c.c. of iodine added are subtracted the c.c. of thio used (calculated to the iodine solution), the remainder representing the mgrms. of Cu directly, and a series of tables are given for the calculation of the percentage of reducing sugars in the presence of varying amounts of sucrose, viz , 10, 5, 2·5, and 1 grm. This procedure was compared with well-known gravimetric and volumetric processes, when it was noticed that, as the result of the cuprous oxide carrying down organic matters from solution during its precipitation, the permanganate procedure gives much higher results than the iodometric. On the other hand, when applying the latter it is necessary to use a correction for the effect of iodine on the product examined. In all methods, gravimetric and volumetric, in which the cuprous oxide is filtered off, an error (probably a small one) arises from the fact that some of the cuprous oxide separates in the colloidal state (due probably to the presence of "protective" non-sugars), passing through the filter-paper in consequence, and leading to a low result.

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[1] *Zeitsch. Zuckerind Cechoslov.*, 45, 2881. [2] *I S J.*, 1922, 298, [3] *I S J* 1924, 162 [4] *Ibid*
[5] *Journal of Biological Chemistry*, 1921, 45, 349, 365.

POLARIZATION RESULTS WITH BEET MOLASSES, USING BASIC LEAD ACETATE AND ALKALINE LEAD NITRATE FOR CLARIFICATION.

Rudolf Ofner. *Zeitschrift fur die Zuckerindustrie der Czechoslovakia, 1925, 49, No. 29, 225-226.*

Standard methods for the analysis of sugar factory products prescribe (in Czecho-Slovakia) both basic lead acetate and Herles' alkaline lead nitrate for the clarification of molasses previous to polarization; but, according to the author's results here reproduced, different results are obtained by these methods, the former being from 0·1 to 0·8° V. higher. Not infrequently these differences reach 0·6° V., which, in fact, is outside the limit of error permissible in this analysis (according to Czecho-Slovakian regulations). Sometimes chemists take as the direct polarization the figure obtained after Herles' clarification, whilst the polarization after basic lead acetate clarification is the value used for the determination of sucrose by the Clerget (double polarization) method. It is therefore, of interest, the author remarks, to arrive at a uniform method for clarification before polarization in the analysis of beet molasses.[1]

SPECIFIC ROTATION OF INVERT SUGAR AND THE CLERGET DOUBLE POLARIZATION DIVISOR.[2]

F. W. Zerban. *Journal of the American Chemical Society, 1925, 47, 1104-1111.*

VOSBURGH has shown[3] that, contrary to the opinion held generally, the specific rotation of invert sugar at a given concentration is not the sum of the specific rotations of dextrose and levulose at their partial concentrations, but one-half of the sum of the specific rotations of the two sugars at the total sugar concentration BROWNE has already pointed out the significance of Vosburgh's conclusions for practical sugar analysis, VOSBURGH did not formulate from his results an equation for the specific rotation of invert sugar, nor did he make any comparisons with the values obtained by former investigators Since the specific rotation of invert sugar is not only an important physical constant, but also forms the basis of the Clerget double polarization divisor, it was decided to make use of Vosburgh's data for the purpose just mentioned. A critical study of the literature shows that Burkhard's, Borntrager's, and Hammerschmidt's figures cannot be used for establishing an equation for the specific rotation of pure invert sugar. It is also found that Gubbe's values are low, and Ost's high, as compared with the best available information. Landolt's equation is the result of converting Gubbe's formula for q into one for p. And, from Vosburgh's data for levulose, Tollens' for glucose, and from Vosburgh's rule concerning the rotation of sugar mixtures, the following equation is developed: $[\alpha]^{20}_{D}$ of invert sugar $= -(19{\cdot}415 + 0{\cdot}07065c - 0{\cdot}00054c^2)$. Vosburgh's experimental figures agree well with this formula. The temperature-correction formula is found to be $[\alpha]^{t}_{D} = [\alpha]^{20}_{D} + (0{\cdot}283 + 0{\cdot}0014c)\ (t - 20)$. The first formula gives −5·554° circular for the rotation of the inverted half-normal weight of sucrose in 100 c.c. at 20°. By converting this into the negative constituent of the Clerget divisor for pure invert sugar by means of the general factor 0·34657, a value of 32·05 is obtained. Landolt's conversion factor for invert sugar, 0·3432, results in the extremely high value 32·37. In a redetermination of this conversion factor for invert sugar 0·34615 was found, from which 32·09 is obtained. It appears, therefore, that the accepted value of 32·00 is slightly too low.

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[1] For other results along this line see *I.S.J.*, 1924, 278,499

[2] Contribution from the New York Sugar Trade Laboratory

[3] *J. Amer. Chem. Soc.*, 1921, 43, 219.

"LUMINA" SPECTACLES FOR COLOUR COMPARISONS IN ARTIFICIAL LIGHT. *Communication to this Journal from the suppliers of the apparatus.*

Every refiner and white sugar manufacturer knows that crystals observed by artificial light may appear quite different when examined next day, so that a yellowish tinge, for example, may then become detectable. But this difficulty may be obviated by the use of "Lumina" spectacles, through which at night colours appear as by daylight, this being the result of the passage of the light through specially prepared lenses. Dr. **HERMANN WEISZ**, of Vienna, their inventor, recommends them for general use in laboratories where many kinds of work are difficult to perform in artificial light, and their application is a wide one. In the sugar laboratory, they are particularly valuable for comparing white crystals, for operating colorimeters, for examining the result of blueing sugars, and not least for colorimetric determinations. But their great use in the factory and refinery is for obtaining reliable indications by means of test papers, such as, litmus, *pH* papers, etc., and for this purpose alone they should be in good demand throughout our industry.

MONOCHROMATIC DEVICE FOR POLARISCOPE ILLUMINATION, ETC[1] *H. B. Gordon. Journal of the American Chemical Society, 1925, 47, 1045-1046.*

A Bunsen burner is used But its air inlet is completely covered by means of an enclosed circular trough of porcelain, in which a wire of platinum (or nichrome, etc.) lies covered with the sodium or other salt, the end of the wire passing through the outer wall. This wire is heated electrically, the result being that the salt covering it is vaporized, and the vapour thus being drawn into the burner, and thoroughly mixed with the gas. This device is continuous, giving a flame of an intensity which may be increased or decreased with the current passing along the vapourizing wire

ASH DETERMINATION ELECTROLYTICALLY OF JUICES, SYRUPS, MASSECUITES, MOLASSES, ETC *F. Tödt. Vereins-Zeitschrift, 1925, 429-439.*

LANGE,[2] and later **TRENKLER**,[3] have shown that the percentage of soluble salts present in sugar products can be found very accurately by determining the electrical conductivity of solutions of samples of known concentration; but, owing to the somewhat involved type of apparatus used by them, the method has not become standard practice. In addition to a vessel for measuring the conductivity, they used a **KOHLRAUSCH** bridge, an induction coil with a source of current, and lastly a telephone, the value found being then calculated by the **WHEATSTONE** bridge ratio into the conductivity before the ash content could be read from a table. But, recognizing the possibilities of the method, the author has collaborated with a firm of instrument makers to simplify the apparatus, employing a special measuring bridge with telephone, this bridge being provided with a scale giving the percentage of ash directly. This is possible by the use of **LANGE**'s carefully compiled tables,[4] if the capacity of the electrode vessels has been established by means of a solution of known conductivity. Adjustment, as the result of the convenient arrangement of the resistance, is so sharp that untrained persons can at once make a determination of the ash without trouble several times more exactly than is possible by the gravimetric method. Calibration of the apparatus is carried out by means of a solution of potassium chloride, as directly by **KOHLRAUSCH** and **HOLBORN**,[5] the resistance capacity being calculated from the formula: $C = k\ w$, where C is the capacity, k the specific conductivity, and w the resistance. The accuracy of the method with 0·5 per cent. of ash is about 0·2 per cent. of the ash (or about 0·001 per cent. of the sample); and with 1 per cent., about 0·3 (or 0·003 per cent.); but with a greater amount of ash the error increases, so that suitable dilution of the product (whatever it may be) is necessitated to bring it within the optimum range It enables one to make an ash determination in about one-tenth of the time demanded by the gravimetric method (solutions being measured, instead of being weighed), whilst lastly, the item of expenditure for gas is obviated—an important cost when spread over a period of time.

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[1] Other devices for the same purpose are described in *I.S.J.*, 1923, 549, 1924, 54, 111, 222

[2] *I.S.J.*, 1910, 423.

[3] *I.S.J.*, 1911, 501

[4] *Ibid.*

[5] "Das Leitvermögen der Elektrolyte" Pages 76 and 77.

INDUSTRIAL APPLICATIONS OF INVERTASE *H. S Paine and C. F. Walton, and M S Badollet* *Industrial and Engineering Chemistry, 1925, 17, No 5, 425-450* The use of invertase as a catalyst for sucrose inversion has been successfully industrialized in the case of a number of commercial products in which sucrose is the principal saccharine constituent Suitable procedures for invertase inversion of sucrose in golden syrup, cane and sorghum syrups, maple syrup and maple cream, and fondant types of confectionery have been devised —A BRIEF ACCOUNT OF THE REFINING OF SUGAR *C. M Keyworth* *Chemistry and Industry, 1925, 44, No 29, 723-725* In this short outline the application of decolorizing carbons in refining is described, it being stated that they may be used to advantage with raw sugars of good quality which filter readily, and have a fairly light colour, the chief disadvantages being high original cost, incomplete removal of colouring matters, and difficulty in filtering when the sugars contain much gummy and waxy matters It is concluded that "a carbon is required which should be sufficiently cheap to be thrown away after once being used," while being a good decolorizer and filter-aid.—SPECIFICATION FOR ANALYTICAL REAGENTS *W. D. Collins, and others* *Industrial and Engineering Chemistry, 1925, 17, No 7, 756-760* These are the recommendations of the Committee on Guaranteed Reagents, of the American Chemical Society, in respect of strength and limit of impurities for the principal laboratory chemicals —BENEDICT METHOD OF DETERMINING REDUCING SUGARS *Armand J Quick* *Ibid, 1925, 17, No 7, 729-730* In applying the Benedict method for the determination of "glucose," the reducing value was found to vary with the concentration of the sodium carbonate, this factor becoming the more marked, the more dilute the sugar solution employed —SYNTHETIC SWEETENING AGENTS *W Herzog.* *Zeitsch. angew Chem, 1925, 641-648* This is a review of progress realized during 1923 and 1924 in the direction of endeavouring to synthetize a substitute for sugar —DETERMINATION OF PENTOSANS *F. W Klingstedt* *Zeitsch anal Chem, 1925, 66, 129-160* If distillation in the presence of 12 per cent. HCl be conducted at as low a temperature as possible, practically all the furfuraldehyde from the pentosans can be collected with very little of the derivatives from the hexoses and substances yielding hexoses by hydrolysis (which likewise give condensation products with the phloroglucinol reagents) —BLUE ASBESTOS AS BOILER AND PIPE COVERING *Anon.* *Chemistry and Industry, 1925, 44, No 32, 796* Blue asbestos, compared with white varieties, has longer, stronger, and lighter fibres, more resistant to high temperatures It is a 20 per cent better non-conductor of heat, and is claimed to save 94 per cent of the loss of heat from a steam pipe at 300 lbs pressure, and appears to last indefinitely It also makes a highly efficient packing —SOLUBILITY OF SUCROSE *P. Mondain-Monval* *Comptes rendus, 1925, 181, 37-40* Per 100 grms of water, the solubility values are 180 5 at 9° C , 196 0 grms at 15 8° C , 210 5 at 25 6° C., and 218 grms at 30 5° C —LUBRICATION OF INDUSTRIAL PUMPS *Anon.* *Lubrication,*[1] *1925, 11 No 5, 49-60.* Effective lubrication is discussed in relation to steam or power consumption, maintenance costs, and productive time lost on repairs in respect of reciprocating, centrifugal and rotary pumps —FORMATION OF GUMS BY BACTERIA *A. Fernbach, M. Schoen and S. Hagiward.* *Ann. Brass. Dist, 1924, 23, 321* In 1912 the first two named showed a levulosan-forming bacterium to be unable to produce gum except from nascent levulose produced by the bacterium itself in the hydrolysis of sucrose. They now discover that *Leuconostoc dextranicus* acts similarly in respect of dextrose, producing the gum from sucrose, but not from sucrose after inversion, neither from dextrose nor levulose

J P O

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[1] Organ of The Texas Co, U.S A

Review of Recent Patents.[1]

UNITED KINGDOM.

Liquid Level Regulating Apparatus for Evaporators, etc. *Naamlooze Vennootschap de Nederlandsch-Indische Industrie,* of The Hague, Holland. *235,206.* June 5th, 1925; convention date, June 5th, 1924.

FIG. 1.

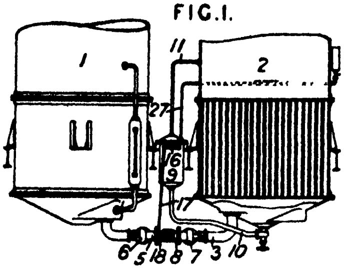


FIG. 2.

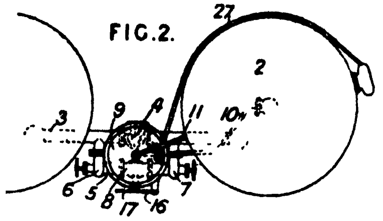
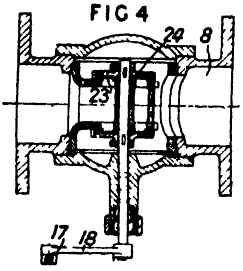


FIG 4



In regulating the supply or discharge of liquid in evaporators, etc., a constant flow of a quantity below that required for normal working is arranged and an additional flow of varying quantity is regulated automatically by the level of liquid in the apparatus. As applied for regulating the supply to an evaporating unit *2* from a preceding one *1*, the juice is drawn into the unit *2* through a conduit *3*. The main portion passes through a valve *4*, Fig. *2*; whilst the remainder passes through a by-pass tube *5* having stop valves *6*, *7* and a regulating valve *8* operated through links *16*, *17*, *18* from a float in a chamber *9* which communicates by pipes *10*, *11* with the liquid and steam spaces of the evaporator. Valve *8* is formed by apertured plates *24*, Fig. *4*, moved over stationary plates *23* having corresponding apertures. A small clearance is left between the plates to allow continuous leakage of liquid and prevent deposition of crystals. Liquid also flows continuously through the float chamber *9* from a pipe *27* to prevent crystallization in the chamber.

Apparatus for delivering Sugar, and Casters for Sugar, etc. (*A*) *E. O Farley,* of Brisbane, Australia. *234,726.* December 16th, 1924. (*B*) *C. Rettmeyer,* of Hamburg, Germany. *234,402.* January 2nd, 1925.

(*A*) Comprises a particular construction of the type (presumably for small scale use, e.g., in restaurants) having a container provided with an opening in the bottom below which is slidably carried a cup or measure provided with a hinged floor An extension is furnished to close the opening in the container. The measure is drawn forward against the influence of a spring under tension, a tail part closing the opening in the container. As the measure is pulled beyond the front edge of the opening, the hinged floor drops, discharging the contents. The measure is returned by the spring.

(*B*) A caster for sugar, etc. (and other granular products caking under hygroscopic conditions) comprises a hollow perforated body filled with a hygroscopic mass, e g , calcium chloride, the apertures in which do not register with holes in a top when the outlet holes register for discharge of contents, but which do register when the cap is rotated to close the discharge aperture. The hygroscopic agent thus keeps the air dry, but does not come into direct contact with the sugar, etc.

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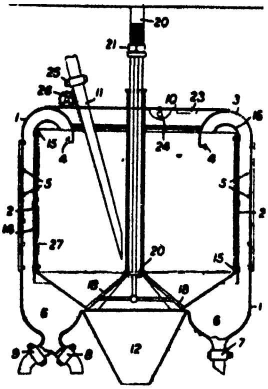
[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

CENTRIFUGAL FILTRATION OF SYRUP, ETC. *J. J. Ragg*, of Lautoka, Fiji. *233,337*. April 27th, 1925; convention date, April 30th, 1924.

Syrups or solutions obtained in the manufacture of sugar are subjected to centrifugal action in a perforated basket covered with a filter-cloth having a layer of non-adhesive friable material. The outer tank *1* has an upper curved rim *3* extending inwards over a similar rim *16* on the basket *2* and carrying spraying jets *4*. Spraying jets *5* are also fitted on the wall of the tank. At the lower end of the tank is a deep gutter *6* with discharge cocks *7*, *8*, *9*. The movable top *10* of the tank has a glass window *23* and a lamp *24*. The feed pipe *11* passes through the top and can be adjusted by rack-and-pinion gear *26* according to the depth of deposit in the basket. The wall *2* of the basket is of perforated metal with strengthening bands or loops, and has on its inner side a close-fitting layer of metallic gauze of fine mesh; over this is a layer of filter-cloth *14* held in place by spring rings *15* A second cloth *27* is supported over the first cloth *14* by loops at one end and has a layer of fine coral sand; or the space between the cloths may contain paper, sand, calcium phosphate, felt, or the like to prevent the solid impurities from coming into contact with the filter-cloth *14*. The basket bottom has discharge openings which can be closed by trap-doors *18* operated by rods sliding in grooves in the driving shaft *20* when the nut *21* is loosened. The liquid to be clarified and filtered is introduced through the pipe *11*, the flow being regulated by the cock *25* and the basket is rotated; the filtered liquid is drawn off through the cock *7*. To cleanse the basket, the cock *7* is closed, steam and hot water are sprayed from the jets on to the deposit; and the solution from this is withdrawn through the cock *8*. The rotation is stopped, the trap-doors *18* opened for the discharge of the mud through the chamber *12*, the cover filter-cloth *27* is removed, the basket is rotated slowly, and the main cloth *14* is sprayed from each side, the liquid being drawn off through the cock *9*. Then the machine is ready for use again.



TREATMENT OF KIESELGUHR FOR INCREASING ITS FILTERING CAPACITY. *F. W. Golby* (*Celite Company*, of Los Angeles, Cal., U.S.A.). *234,735*; addition to *229,021*. December 28th, 1923.

The process described in the parent specification,[1] by which diatomaceous earth is prepared for use as a filtering agent in the purification of sugar solutions, oils and waste and other liquids, and as an ingredient in soap, paints, and dental preparations, by calcining in admixture with the salt of an alkali or alkaline earth, is modified in that the finely divided earth is calcined without addition of other material.

FILTERING AND STERILIZING LIQUIDS (USING ACTIVE CARBON). *H. E. Potts* (*Naamlooze Vennootschaap Algemeene Norit Mattschappij*, of 2, den Texstraat, Amsterdam, Holland). *234,149*. December 20th, 1923.

Liquids, especially water, are filtered and sterilized by passage through a layer of active carbon which has been treated with an innocuous acid. Previously treated carbon may be placed in the filter while still containing a substantial amount of acid or the carbon may be treated with acid after being placed in the filter. Hydrochloric acid, preferably in gaseous form, may be used. Or the carbon may be subjected to the action of chlorine which is converted into hydrochloric acid by the catalytic properties of the carbon. (Specifications 155,610, 166,229, and 202,654 are referred to). Reference has been directed by the Comptroller to Specification 198,378 (as open to inspection under Sect. 91 of the Act).

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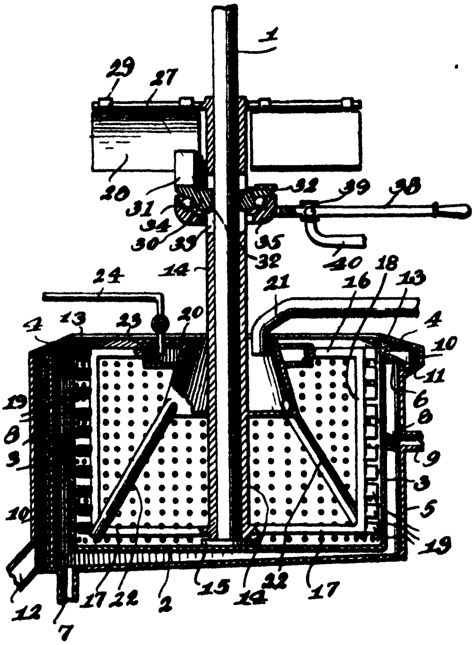
[1] *I.S.J.*, 1925, 337.

UNITED STATES.

Centrifugal Machines. *Amédeé C. Snyers*, of New Orleans, La., U.S.A. 1 522,393. January 6th, 1925.

In operating the invention described, the centrifugal is set in motion, massecuite is admitted through spout 21, and is delivered thereby into the bowl 20, wherein it is whirled to the periphery, being forced down the pipes 22 and made to issue from the lower ends of these pipes and against the basket wall behind the lowermost blades 19, thus constantly refilling the empty space just created by the lifting action of said blades. As soon as there is sufficient massecuite, and the blades 19, of the discharge become embedded in it, this massecuite locks the discharger to the basket and causes it to revolve with the latter. But now the air resistance encountered by the wings 28 retards the rotation of the discharger which begins to revolve relatively to the basket, causing the blades 19 to go through the mass. At the same time, owing to their inclination, each of these blades lifts successively all the parts of the annular zone or strip of mass which it engages, which is possible from the fact that each blade, beginning with the uppermost, by lifting the mass creates under it an empty space ready to receive the mass lifted by the next lower blade. Thus the whole coat of mass lining wall 3 is gradually propelled upwards, at the same time becoming purged sugar, as it is gradually deprived of the molasses, the molasses of course being forced by the centrifugal power through the perforated wall 3 and collected in the casing 5, where it escapes through outlets 7 and 9.



When the sugar reaches the level of flange 4, the topmost zone is lifted by the topmost blade 19 above said flange and is ejected against the flange 13 which directs such purged sugar crystals into the channel formed between walls 6 and 10. The steep bottom 11 of this channel affects a quick movement of the sugar to the escape outlet 12. When it is necessary to wash the sugar, the work is regulated so that the massecuite is practically deprived of its molasses when it reaches the level of the gutter 8. Water is admitted through pipe 24 to the bowl 23 in a continuous stream. The water is at once forced by the centrifugal through pipes 25 down to their perforated extensions 26 and through the perforations, to be forcibly projected against the sugar. The resulting washings traverse wall 3, are collected in casing 5 above gutter 8, drip down into said gutter and flow off through outlet 9, being thus automatically collected separately from the pure molasses. In this case all of the molasses is collected in the casing 5 below the gutter 8 and evacuated through the outlet 7.

The steadily entering flow of massecuite from spout 21 continuously refills the empty space created at the bottom of wall 3 by the lower blades of the discharger, and it is thus seen that all operations of discharging the centrifugal, purging the massecuite, eventually washing the sugar and discharging the latter from the basket, can proceed in a continuous and automatic manner. The proper work required from the centrifugal is obtained by regulating the admission through spout 21, and the speed of the discharger relatively to the basket, this latter being done by adjusting the resistance encountered by the wings 28 in a manner described above.

Filter and Process of Filtration. *R. A. Demme* (assignor to *Darco Corporation*, of Wilmington, Delaware, U.S.A.) *1,524,916*. February 3rd, 1925.

It is explained that in filter-presses the least pressure is at the point where pressure does useful work, namely, the filtering surface, whereas the greatest pressure is in the pump. In most cases where the quantity of liquor to be filtered is large, and particularly with thick or viscous liquids, the pressure required is quite high and it also must be maintained over relatively long periods of time. In operating a filter-press under pump pressure, only a relatively small fraction of the total initial pressure generated by the external pump is useful in forcing the liquor through the cloth. In this invention these difficulties are obviated by generating the filtering pressure at the filtering surface itself, the course of pressure being an integral part of the filter itself.

In the drawing, element *1* is a two-part cylindrical casing mounted on standards *2* and closed at the ends by disc elements *3* and *4*. Interiorly, the periphery of the drum is provided with suitable grooves *5* leading to discharge outlets *6*. Resting on this grooved and corrugated surface is a filter-cloth or the like. As shown (see Fig. 3), the filter-cloth *7* is protected on each side by a metal filtering screen *8* of wire-cloth or perforated metal. At the ends the cloth is held between the ends of the cylinder and the end discs. It is convenient to make the casing in two parts, A and B, flanged together (see Fig. 2) at *9* and *10*. The filter-cloth and screen similarly may be made in two sections with the ends held between flanges *9* and *10*; or it may be one piece of material with a fold on one side and the lapped ends at the other. As will be observed, by removing bolts *11* the whole structure can be readily disassembled; the top being lifted off and the filter screens taken out. Within the cylinder is a rotatable shaft *12* which may be hollow and serve as a feeding means for liquor to be treated, being provided with orifices *13* for that purpose It is journaled at one end in stationary tubular feeding means *14*, the other end being provided with driving means *15*. The shaft carries a plurality of closely associated vanes *16*. Instead of feeding liquor into the device through the tubular shaft, feed may be had through the valved inlet *17* passing through one of the end closures. Outflow may be through valved outlet *18*, which leads to a coarse open-meshed filter-cloth of coarse straining fabric *19* arranged, for instance, as a bag filter in casing *20*. Strained or separated liquor from this casing may be returned through *21* to the inlet of the device. In treating hot liquors the whole device may be steam jacketed or otherwise heated.

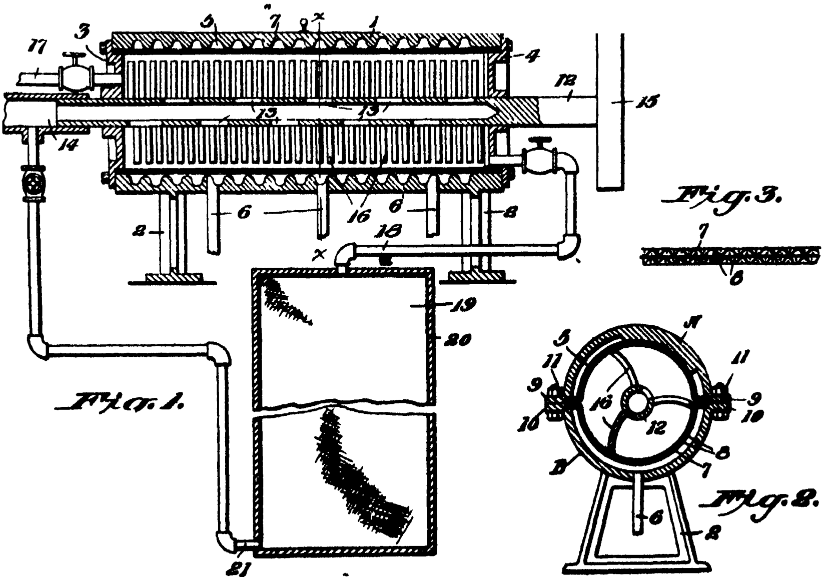


Fig. 1.

Fig. 2.

Fig. 3.

Presuming the structure shown is to be used with a liquor carrying solids which are to be removed, the liquor to be treated passes in through *14* (or *17*). The vanes *16* being in rapid rotation, centrifugal pressure is produced next the inner periphery of the cylinder; that is, next the filter-member proper. The pressure is the most intense at this point. Liquid passes through and emerges at *6*. Usually the feed is managed so that more liquid passes into the cylinder in a time interval than is discharged at *6*. The residue passes out through *18* and is strained at *19* to bring the proportion of liquids and solids nearer that of the original liquid. Naturally the liquid passing out at *18* carries a greater proportion of solids than that entering at *14*. With the connexions as shown, the liquid strained into *20* will be drawn back by the suction of the device through *21* for repassage together with fresh liquor going through *14*. All the solids in the liquid treated in the end accumulate at *19*, except the small amount on the inner face of the filter member. The filter-member therefore may be used for an indefinitely long period.

IMPROVING THE FILTERING QUALITIES OF KIESELGUHR. *Robert Calvert, Karl L. Dern, and Gordon A. Alles*, of Lompoc, Cal., U.S.A. *1,502,547*. July 22nd, 1924.

It has been found by the inventors that by mixing diatomaceous earth with a small proportion of any of several different chemicals, particularly sodium chloride and heating the mixture to a suitable temperature, a substantially new product is formed, such product being in general substantially white in colour and of lower apparent density than the earth from which it was prepared; also that when the material so prepared is used as a filter-aid in the clarification of sugar solutions, it has a much greater filtering capacity than the original material The process may be carried out as follows: 100 lbs. diatomaceous earth is mixed with 5 lbs. of sodium chloride (common salt) and the mixture ground so as to reduce both the diatomaceous earth and the salt to a state of powder to give an intimate mixture. The mixture is charged into a muffle furnace and heated to about 1800°F., at which temperature it is maintained for one hour. The product is removed from the furnace, and reground to powder, if necessary, although in some cases such regrinding is not required. Kieselguhr thus treated may be tested for efficiency as a filter-aid in the following manner: 60 lbs raw cane sugar is dissolved in 40 lbs. water at 80°C., and to the solution is added 0 8 lbs. of the calcined product produced as above described. On pumping through a filter-press with a surface area of 0·37 sq. ft., there is obtained in 12 minutes a filtrate weighing 35 lbs. as compared with only 6·1 lbs when diatomaceous earth without this treatment is used. The product is considerably lighter in weight than the ordinary diatomaceous earth which has not been subjected to the treatment, the material produced by the process as described occupying more than 50 per cent. greater volume than the same weight of ordinary diatomaceous earth. The weight of the diatomaceous earth treated as described is about 10 lbs. per cub. ft (wet density) as compared with a weight of about 17 lbs. per cub. ft. in the case of ordinary untreated powdered diatomaceous earth. This increase in bulkiness is permanent.

PRODUCTION AND REVIVIFICATION OF ACTIVE (DECOLORIZING) CARBON. (*A*) *Erwin Schmidt* (Assignor to the *Gesellschaft fur chemische Produktion m. b. H.* of Mannheim-Waldhof, Germany). *1,527,083*. February 17th, 1925. (*B*) *Rudolf Adler*, of Carlsbad, Czecho-Slovakia. *1,530,536*. March 24th, 1925.

(*A*) It has been found that an extremely highly activated carbon, which is also very suitable for gas absorption is obtained, if in place of passive refractory supports, such as pumice, kieselguhr, or silicic acid, absorbent, combustible cellulose-containing supports are used, such as wood, cork waste, straw or some other cellulose-containing substance; and by using sulphite cellulose waste liquor as the primary material for producing the highly active carbon. The method may for instance be carried out by soaking wood, say in the form of small shavings, with sulphite waste liquor, and carbonising it by heating to a temperature. Suitable additions of salts and the like may be used in a known manner.

In this way a granular carbon having an extremely high power of absorption is obtained (which is also suitable for the absorption of gas). Experiments have shown that the activity of such carbons is as a rule even higher than that of carbons obtained from untreated or preliminarily treated sulphite waste liquor alone (without support) by carbonization. By carbonizing the support as well, the activity of the product is not reduced (as might be expected), but is considerably increased.

(*B*) Claim is made for the process of producing a highly active decolorizing carbon from waste sulphite liquor, which consists in adding lime, thereby precipitating the precipitable organic constituents of these liquors (especially the lignin substances), separating the precipitate by filtration, then mixing it with alkali compounds, so as to impart to it an alkaline reaction, carbonizing the resulting solution, leaving the decolorizing carbon with water and finally drying it

RUST-REMOVING LIQUID COMPOSITION, ITS PREPARATION FROM STEFFEN WASTE WATER.

Glen. L. Williams (assignor to *Randall Williams Co.*, of Detroit, Mich., U.S.A.). *1,514,494.* November 4th, 1924.

A preferred method of preparing the liquid is to dissolve nickel, copper, zinc, or manganese phosphates in water. Any one of these separately or any combination of the four salts mentioned may be used. To the solution, aqua regia is added, and then before the acid has acted upon the salt solution, evaporated Steffins waste-water is added This beet sugar factory residue is alkaline in reaction and contains an amount of colloidal with other organic matter When the solution is formed in this manner, it forms a liquid which when heated substantially to boiling point will act upon rusted iron or sheet steel placed within the solution to remove the rust. Not only this, but it forms a uniform dark coating which is a very satisfactory rust-resisting substance.

FERMENTATION OF MOLASSES FOR THE PRODUCTION OF BUTYL ALCOHOL AND ACETONE.

Guy C. Robinson (assignor to the *Atlas Powder Company*, of Wilmington, Delaware, U.S.A.). *1,510,526.* October 7th, 1924.

The inventor has discovered that all the sugars present in molasses, such as black-strap, namely, sucrose, dextrose, levulose, and raffinose, are fermented readily by organisms of the granulobacter type which are suitable for the butyl alcohol fermentation. Furthermore that molasses is deficient in available nitrogen and also that it contains various toxic constituents, such as polyphenols, etc., and mineral salts which retard the fermentation when performed in the ordinary manner. He has devised a method whereby successful and complete fermentations can be carried out with molasses alone or with mixtures of molasses and corn or other cereal mashes in various proportions. He found that the mineral ash isolated from such molasses possessed a toxic influence on the normal growth and development of bacteria of different types. This inhibition was very marked in the fermentation of corn mash with bacteria of the granulobacter type, and it was discovered that this inhibition was due to the prevention of normal cell division. From this he concluded that if this interference with cell multiplication could be prevented, molasses would ferment normally as do cereal mashes and pure sugar solutions. Being aware that the first stage of the normal butyl fermentation is the stage of rapid cell division, he conceived the idea of adding the molasses to a normally fermenting corn or other cereal mash after this first stage of rapid cell division has reached its height. Under these conditions he found that the molasses fermented throughout normally and completely. He has also discovered that a molasses mash can be fermented satisfactorily by adding a large volume of seed culture previously prepared in corn meal mash; furthermore that molasses yields a more rapid fermentation accompanied by better yields of neutral volatile products, if it is first purified by treatment with an activated decolorising carbon, so as to remove toxic principals, such as polyphenols, etc.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1925. Tons.		1924. Tons
Total Receipts, January 1st to August 26th	2,425,853	..	2,321,604
Deliveries ,, ,, ...	2,349,371	..	2,285,034
Meltings by Refiners ,, ,, ...	2,272,580	..	2,212,710
Exports of Refined ,, ,, ..	172,000	..	137,000
Importers' Stocks, August 26th	76,482	..	37,364
Total Stocks, August 26th	165,280	..	114,927
	1924.		1923.
Total Consumption for twelve months	4,854,479	..	4,780,684

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1922-1923,
1923-1924, AND 1924-1925.

(Tons of 2,240 lbs.)	1922-23 Tons.	1923-24 Tons	1924-25 Tons.
Exports	2,746,613	.. 2,909,728	.. 3,440,894
Stocks	519,996	.. 570,802	.. 970,025
	3,266,609	3,480,530	4,410,919
Local Consumption	77,500	.. 72,500	.. 87,000
Receipts at Ports to July 31st	3,344,109	3,553,030	4,497,919

Havana, July 31st, 1925 J. GUMA. - L. MEJER

European Beet Crop.

(Latest Estimate of Sowings, after Licht.)

	1925–26 Hectares.		1924–25 Hectares.
Germany	366,764	....	351,682
Czecho-Slovakia	304,000	..	302,681
France	206,640	....	214,000
Holland	66,217	....	73,930
Belgium	72,000	....	80,591
Sweden	40,312	....	41,130
Denmark	38,000	...	37,400
Poland	176,709	....	168,167
Hungary	66,436	....	74,414
Austria	20,625	....	18,610
Rumania	61,500	....	53,712
Jugo-Slavia..	35,000	....	55,000
Italy	60,000	. ..	136,300
Russia	440,000	....	343,182
Other countries	130,000	....	132,200
Hectares	2,084,203	....	2,082,999
Acres	5,150,066	....	5,147,091

United Kingdom Monthly Sugar Report.

Our last report was dated the 11th August, 1925.

The general easy tendency which prevailed last month continued for the whole period under review and prices for all descriptions show a fall of 6d. to 9d. per cwt.

The London Terminal Market has been dull and easier, and prices seem to have reached a point when operations are restricted. Speculators do not care to liquidate until they are forced and no one seems inclined to start fresh "bear" operations at this level. The liquidation of August proceeded quite smoothly and this month finally went out at 15s. 10½d. The tenders in August amounted to nearly 10,000 tons in spite of the enormous liquidation of this month which took place. September fluctuated in sympathy with August and fell latterly from 16s. to 15s. 3d. Business in new crop was rather restricted and showed little enterprise. October and December fell from 15s. 9d. to 15s. 3d. March was traded in from 16s. to 15s. 6¾d. to 15s. 8¼d. May from 16s. 3d. to 15s. 8¼d. to 15s. 9¾d. and August from 15s. 11¼d. to 16s. 0¾d.

Trading in actual sugars was not quite so brisk as in the early part of August, Russia bought 25,000/30,000 tons of American granulated as there was little Continental sugar available. The trade continued to buy only actually what they required, and this demand was chiefly satisfied by the English refiners. Spot Dutch Granulated sold from 29s. 9d. to 29s. 6d., whilst American owing to its poor quality generally sold at 6d to 9d. under this price. American c.i.f. sold from 16s. 9d. to 16s. 4½d., White Javas sold on the spot from 28s. 9d. to 28s. 6d., whilst c.i.f. was sold from 15s. 9d. to 15s. 4½d. There were sellers of Polish Crystals for November/December at 15s. 1½d. and Belgian Crystals were offered for the same delivery at 15s. 3d. Czecho Granulated sold down to 15s. 9d. for November/December and Granulated for 1926 could be secured round about 16s. 3d.

The British refiners advanced their prices by 3d. per cwt. on August 18th and they were reduced again by a similar figure on the 3rd September. The latest prices are No. 1 Cubes 34s. 9d., London Granulated 30s. 4½d.

Business in Raws has been fair, Cuban 96 per cent. fell from 12s. 3d. to 11s 10½d. c.i.f. and about 50,000 tons were sold at this latter price. San Domingoes sold at 12s, Mauritius at 17s., Natal 96 per cent. sold at 15s. 7½d.

In New York a good business has been done in Raws up to 2⅝ cents but latterly this price has eased off a bit.

The Futures market has continued to drop and to-day is generally 20 points lower than last month.

The Cuban crop progresses satisfactorily and receipts to date are 950,000 tons more than last year. Stocks at the ports to-day are 772,943 tons against 382,352 tons this time last year.

Reports from the Continent are on the whole favourable for the growing crop. Hot, dry, and warm weather with ample sunshine is needed for the harvest. The latest figures are as follows:—

AVERAGE WEIGHT OF ROOTS WITHOUT LEAVES.

Germany	3rd September, 1925,	400 grms.	1924,	402 grms.
France	2nd „	420 „	„	432 „
Czecho-Slovakia	24th August, 1925,	402 „	„	358 „

SUGAR

Germany	1925,	15·1.	1924,	16·1.
France..	„	13·51.	„	16·35.
Czecho-Slovakia	„	14·32.	„	16·39.

21, Mincing Lane,
London, E.C. 3.
September 9th, 1925.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable, but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

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Notes and Comments.

The 1925-26 Beet Campaign in England.

Soon after this number appears the sugar beet campaign in this country should be in full swing. As compared with last year when three factories were at work, there should be seven operating this Autumn. Ely is to be formally opened by the Minister of Agriculture and Fisheries on October 15th, while Wissington is expected to be completed a week or two later. Some 56,000 acres have been sown this season as compared with only 22,000 last year, and nearly 70,000 tons of sugar is expected as compared with 26,000 last year. The acreages and yields of the various factories are expected to be approximately as follows: Bury St. Edmunds, 7000 acres and 6500 tons; Cantley, 16,300 acres and 17,000 tons; Colwick, 7500 acres and 9400 tons; Earlestown, 250 acres and 250 tons; Ely, 5900 acres and 6000 tons; Ipswich, 4000 acres and 3500 tons; Kelham, 5800 acres and 6300 tons; Kidderminster, 2500 acres and 3125 tons; Spalding, 4000 acres and 5000 tons; and Wissington, 4500 acres and 4600 tons.

Projects for further factories continue to be announced. The Anglo-Scottish Beet Sugar Corporation have decided to proceed immediately with the erection of a factory at Cupar, Fife, the response from neighbouring farmers having been satisfactory. This will presumably start in 1926. Messrs. Armstrong, Whitworth & Co.'s association with Messrs. Breitfeld, Danek & Co. has resulted in a decision to erect a factory in East Suffolk, capable of dealing at the outset with some 10,000 tons of sugar. The area served will be midway between the existing Cantley and Ipswich factories. Finally, it may be added that the Saukey Sugar Company in Lancashire, who are adapting their refinery to deal with a beet crop, are associating themselves with the Anglo-Dutch group of factories so as to obtain the benefit of their experience.

Training Technologists for Home Beet Factories.

An educational scheme for the training of specialist technical officers for beet sugar factories in this country has recently been drawn up by a committee acting under the aegis of the British Sugar Beet Society. The number of such specialists required for each factory is considered to be eight or nine, including a Technical

Manager, one or two Assistant Technical Managers, two Shift Superintendents, a Chief Chemist, and three Assistant Chemists. To qualify for such posts it is proposed that candidates should have a course of training in general science and in sugar technology at a University, supplemented by practical experience in a beet sugar factory for several years. A Diploma in Beet Sugar Technology will be granted to successful candidates. It is proposed that the training should be confined ordinarily to men who have recently secured the degree of Bachelor of Science, and it is hoped that the Universities concerned may allow beet sugar technology to form an optional subject in Applied Chemistry for that degree, in which event the training could be included in the Degree course instead of following it.

Failing the training in the University course, the course of beet sugar technology would occupy about two years, comprising some three terms, which would consist of a first term from Autumn to Spring of study at any approved institution, a second term from the following October to January at the beet sugar factory, and a third term, of academical study from January to June or July. The student would attend the factory as an unpaid technical volunteer, working side by side with the men and spending at least a week at each station in the factory.

Further particulars as to the courses of instruction can be obtained from Mr. ALFRED WOOD (Secretary to the Committee), at 6, Lancaster Place, Wellington Street, London, W.C. 2.

The Need for Efficient Agriculture.

In the October number of *Tropical Agriculture* Professor J. SYDNEY DASH has a thoughtful article on the need for much greater efficiency in agriculture—in the tropics in particular—not only in its scientific but also in its economic aspect.

As regards the scientific side he quotes a writer as saying that "the benefits scientific knowledge has conferred upon agriculture are not to be depreciated, but for the last two centuries they have been so enthusiastically stated that there is now little doubt of the exaggerations of the protagonists." This writer, however, believes that the farmer or agriculturist has not made the most complete use of the knowledge and learning investigators have placed at his disposal. Many competent observers are of the opinion that the amount of scientific investigation already carried out has not yielded results compatible with the effort made. In this connexion stress is usually laid on the operation of the law of diminishing returns, or rather disproportionate returns, that, irrespective of scientific advances in agriculture, will always operate at some point to render nugatory the application of additional expenditure of capital and labour towards increased output. This of course is no argument against the need for research; but research cannot be hurried, and in the meantime much can be done in other directions. Incidentally, Professor DASH mentions that methods of dissemination of agricultural knowledge are open to a great deal of criticism, it being claimed by some that there is already an appalling mass of information in undigested form which accounts for the wide divergence between present-day knowledge and practice.

But it is with the present economic system and the question of agricultural costs that Professor DASH is most concerned, for it is in this direction that fresh ground must be broken if, in the tropics, one is to avoid the various economic ills that threaten. Only by adjusting one's agriculture to the new outlook can one hope to draw the maximum profits from scientific research. We must seek by every possible means to render ineffective the law of diminishing returns by efficiency at all stages, not only in methods but in management. In other words, declares the Professor, agriculture in the tropics must adopt the policies of the big enterprise, and work on a big co-operative scale. The small farm is economically a weak unit, while intellectually it tends to become hidebound and unprogressive—it is more difficult to carry enlightenment to it or get new developments of science put into its practice. Peasant agriculture is an obvious handicap; it may be inevitable in some places, but without some form of organized control it tends to retrogress rather than progress; as an instance, those West Indian islands where the small cultivator predominates are the worst off economically.

Hawaii contrasted with Cuba..

Professor Dash gives a few examples from the sugar world of how the economic problem in agriculture is dealt with, and in so doing contrasts Hawaiian practice with Cuban. To quote him, in Hawaii "expenditure is on a generous scale in every department, both in field and factory, the two proceeding along well-balanced lines. Besides, as is well-known, a considerable sum is spent directly on research, and the whole industry appears to be so effectually organized that it is in a position to apply the results at every stage in production, thereby obtaining a maximum profit from the outlay. Recent reports indicate great prosperity in spite of the comparatively low levels touched by the raw product during the past year. Thus, the point at which the law of diminishing returns operates has been pushed steadily forward. There are indications of a similar prosperity in Java where efficiency in both field and factory has laid the foundations of permanency in the industry.

"Turning to the West Indies we find a different picture. F. S. Earle writes: 'Sugar-cane agriculture in the West Indies is 50 years behind the manufacturing side of the industry.' We do not believe this can be disputed. The natural advantages possessed by Cuba, coupled with the preferential treatment in the markets of the United States, have made her the greatest sugar-producing country in the world, but although she heads the list in output, her agriculture is probably the most backward. Those engaged in the industry have set out if possible to defeat the law of diminishing returns by a process which seems destined, if adequate measures are not taken to apply drastic remedies, to have a far-reaching effect on the future outlook. With factories organized on a large and efficient scale in most cases, the object has been all along to secure a cheap supply of cane by the most inefficient agricultural methods—a policy which may prove more costly in the long run. There is scarcely any large scale field organization, but a system of agriculture usually referred to as 'colono' which has steadily gone from bad to worse. Current sugar journals tell us of constantly decreasing yields on the old lands to such a point, that, in numerous instances, cane production has ceased to be remunerative at present prices. We read in *Facts About Sugar* that unless a practical programme for checking declining cane yields is adopted on virgin land estates, any substantial asset provided by these lands will rapidly disappear. It is also stated in the *Cuba Review*, that many hitherto interested in sugar in the Republic, especially planters and mill owners of small capacity, are turning to Henequen and Sisal production. This industry appears to have received a marked stimulus as a result of the unsettled conditions which have prevailed in Yucatan during late years. Here again experience has shown that large scale measures will be necessary to produce a crop profitably. Cuba's hope, therefore, lies in the direction of larger and better field organization without delay, so that she may be ready to apply the results accruing from the researches inaugurated by the Tropical Research Foundation, recently established in the United States for the study of tropical agricultural problems. In other words, she must tear a leaf from Hawaii's book if the industry is to continue to flourish on sound lines. Intensive field methods need not imply increase in total output; on the other hand, much land now yielding little or nothing could be released for other purposes, e.g., fibre growing, etc."

Large Scale Management.

As to the advantages of the new orientation that Professor Dash foresees, these are too obvious to necessitate enumeration, being the antithesis of the disadvantages of the small unit. But it may be laid down that the management of the larger unit can put into practice such aids to efficiency as a system of cost accounting as would be impossible on the small estate. From it could be studied expenditure at every stage in relation to losses and gains; while the better disposition of capital, machinery, labour (usually the highest item in cost of production), and other considerations tending towards reduction in costs, are possible only with the large unit. Moreover all matters relating to improvements could be studied and executed on broad and profitable lines. It would imply scientific management as opposed to amateur guesswork.

This is recognized as a trite truth by the Trinidad College authorities, and to assist in its consummation they intend to add a large estate to the equipment of the College, where it is hoped future estate administrators can be given a substantial training on the lines above indicated.

Recent Conditions in Cuba.

According to a Consular article appearing in *Commerce Reports*, business conditions in Cuba during the first half of the year felt the effects of low sugar prices and a feeling of depression was prevalent. The price of sugar dropped sharply in December, 1924, and it sold for less than 3 cents per lb. at the first of this year. As the season progressed and large supplies became more evident, the price continued its downward trend until the average quotation for the month of May was only slightly above 2·25 cents per lb. A slight improvement occurred in June but, in general, the low level which previously had not been reached since 1922 was maintained. The margin of profit realized from these low prices is regarded as no more than ample in most cases to finance operations and very little surplus is expected to be available to liquidate old balances.

At the beginning of the year, the general feeling of uncertainty caused by low sugar quotations caused importers to slow up in placing orders and cancellations of orders previously placed were numerous. As the season went on, buying in practically all lines was confined to replacements and to immediate needs, and business in general was dull. Collections gradually became more difficult and wholesalers and jobbers in Havana, who had been carrying the retail dealers, found difficulties in collecting the considerable amount owing to them. Continued slackening of buying affected import orders and any marked revival of buying cannot be looked for until the fall.

Although the total outrun of the 1924-25 sugar crop has not been made, it is fairly certain that the final figure will not be far from 5,100,000 tons, according to the estimates of the Cuban Department of Agriculture and Commerce. This crop is the largest that has ever been produced and exceeds the previous year's by approximately 1,000,000 tons. However, due to the low prices which have prevailed, the monetary return on the crop probably will not be as large as that for the 1923-24 crop.

Up to the beginning of July, 4,285,970 tons of sugar had been received at the ports, and of that amount 3,078,647 tons had been exported. The increase in this year's production can be visualized when these figures are compared with those for 1924. Up to the corresponding date of the latter year, 3,442,256 tons had been received at the ports, and of that amount 2,615,180 tons had been exported. The weather during the summer months has been favourable to the progress of the 1925-26 crop.

The Trinidad College of Tropical Agriculture.

The Report of the Governing Body of the Imperial College of Tropical Agriculture, Trinidad, has recently been issued for the year 1924.

The year opened with eighteen Diploma students and six Post Graduates on the register; and at the close the numbers were respectively 18 and 14. This increase is regarded as satisfactory, showing as it does the growing appreciation of the advantages to be derived from the College courses

As regards the personnel, the principal change recorded was the retirement of Sir FRANCIS WATTS as First Principal; he was, however, appointed to the honorary position of Principal Emeritus of the College. His successor was Dr. MARTIN LEAKE, formerly Principal of the Agricultural College at Cawnpore. Other appointments were: Mr. CECIL Y. SHEPHARD, B.Sc, as Lecturer in Economics, to take the place of Prof. W. R. DUNLOP, who had resigned; and Prof. O. F. BOYD, who was selected on the advice of Dr. C. E. COATES, of Baton Rouge, Louisiana, to take the post of Sugar Technologist. The College lost by death two prominent supporters in the persons of LORD MILNER and Mr. CLAUD T. BERTHON, its hon. consulting engineer.

In January, 1924, the first number of *Tropical Agriculture*, the journal of the Imperial College, was published. This was issued monthly during 1924, and the rapid increase in its circulation leads the Governing Body to believe that it is much appreciated and that it fills a useful purpose. We for one have found it a welcome addition to our list of exchanges, and have been glad on frequent occasions to quote from its informatory articles. We trust that as the successor of the now defunct *West Indian Bulletin* it will have a prosperous career as the organ of the Trinidad school of Agriculture.

A Post to fill.

While on the subject of Trinidad College and its personnel, we would refer here to an advertisement appearing on another page applying for the services of a sugar chemist with factory experience, capable of teaching sugar technology, for the post of Professor at the Trinidad College, Applications are to be addressed to Mr. A. E. ASPINALL, C.M.G., at 14, Trinity Square, London, E.C. 3. We understand that this is to fill the post lately occupied by Professor O. F. BOYD who has left the College. In view of the Imperial character of the College and its asset as a training ground for the British sugar industry, it is sincerely to be hoped that the Governors will succeed in finding for the position a Britisher with the requisite experience, and will not need to look further afield for their man.

Fifty Years Ago.

From the "Sugar Cane," October, 1875.

An article appeared in the issue of our predecessor by R. H. BURTON, entitled "The Distillation of Rum," which consisted in the main of conjectures regarding the causes contributing to the quality of "Old Jamaica," as the following extracts show:—

"The quality of the molasses is an object worth consideration. Some persons object to fresh molasses, as being less ready to ferment; but it is well known that molasses taken from a tank where fermentation has been going on for weeks, or months, has decreased in density, and will therefore take a greater quantity to saturate a given number of gallons of wash to a certain degree of density . . . . Planters who wish to make good rum crops should be careful to collect all the sour canes from the cane fields; the suckers and plants, in fact, no portion of the cane unfit for sugar should be lost. If not required for the stock, the leaves only should be cut from the plant, and all the rest passed through the mill. The juice from the tops, suckers and rat-eaten canes make the best of rum. It is this and the skimmings and very frequently cane juice which produce the, Old Jamaica.' Molasses, dunder and water merely make spirit . . . . For myself I have not the slightest doubt the very best rum is made when no dunder is used in the ferment. In making rum for any special purpose, I never have used dunder; it, however, helps to make quantity, and very good rum is made where dunder is liberally used. The rum I have seen made is peculiarly good, and on that estate no water is ever used in the mixing cistern, unless it may be the sweet-water from the coppers on boiling-off day . . . . I remember an old gentleman in the Windward Islands who had always an acre or two of Creole cane, out of which he yearly made rum for himself and his particular friends. He considered the juice of the Creole cane produced a superior rum. These canes are short-jointed, small and soft, and the juice is peculiarly aromatic; by many it is supposed they are indigenous to the West Indies. The best flavoured rum I have ever tasted was made from cane juice skimmings, molasses and water. It was 40 years old—yellow from age and, looking at it in the glass might have been mistaken for oil. But such rum as this could not be bought, neither would it pay to make it for sale . . . . Old planters assert that the richest flavoured rum is made from wash set up sweet and attenuated slowly. They say the best Jamaica is made on estates that make proportionately but a small quantity of sugar. The reasons they assign are that on such estates the liquor loft and cisterns are in proportion to the crop, and nothing is hurried, whereas on estates that have increased their sugar crops without proportionately increasing their distilling plant they have to adopt a quicker method, so as not to be overcrowded with an excess of skimmings and molasses in their cisterns . . . . Wash attenuates best where the vat-room is kept at an even temperature and well ventilated and light, but not when a strong current of air passes over the vats, giving a quicker and better return when distilled, than wash that has been set up in a dark and badly ventilated room. An estate in St. Thomas-in-the-East had a badly ventilated liquor loft, and the return of rum was not good. By accident this was destroyed by fire, and a temporary open shed was fixed up for the vats. The mode of mixing was the same, but the return of rum was now much better. One of the best returns of rum that has come under my notice is on an estate where the vat-room is thoroughly ventilated . . . ."

Cane Cultivation in Porto Rico.

The methods of cane cultivation in the three great tropical colonies of the United States, Hawaii, Porto Rico and the Philippines, differ widely in almost all respects. Those in the first have often been described, and what may be considered "best practice" in the last, is dealt with elsewhere in this number of the Journal. The present article deals with Porto Rico, and consists mainly of a résumé of a paper by F. S. Earle, which forms a sort of introductory chapter to a symposium of about a dozen papers by various authors on different aspects of the industry in that island: most of these are concerned with the plantation side. Although the points of view of the writers on Porto Rico and the Philippines differ considerably, a strong side-light is thrown upon the stage in evolution of the agricultural practice in these two places. In the latter, recent implemental advances are apparently hardly yet in the experimental stage, and the methods described depend chiefly on the most intelligent use of the local resources—native ploughs, water buffaloes, hand work. In the former, a definite attempt is made to utilize a great variety of up-to-date machinery, and eliminate as far as possible all working with the hoe; doubtless largely the result of the author's experience gained since his whole energies have been devoted to the purely agricultural side of plantation work. And as his connexion with Porto Rico has now been finally severed, additional importance is lent to his considered opinion, as to the proper methods to be employed and the particular type of machine which he would recommend on the different soils, irrigated and unirrigated, which are met with in the island.

The paper commences with a statement that, in the West Indies, cane cultivation is 50 years behind the making of sugar. This assertion is presumably based upon Earle's personal experience for many years in Louisiana, Porto Rico and Cuba, the latter being the two greatest sugar producers; it may appear to be somewhat sweeping to those whose experience is limited to the smaller islands where, although sugar cane has been the staple crop for centuries, yet the total production is a mere fraction of the quantity placed by the West Indies on the world's market. It is quite possible, indeed, that the exact converse would be nearer the mark concerning these smaller islands, especially if we could antedate our statement for considerably less than 50 years. On viewing the industry as a whole it would, we think, be justifiable to say that in the British West Indies the cultivation of the cane was good, while the making of sugar from it was, in many respects, at least primitive!

In Earle's paper the importance of adequate tillage is emphasized all through, with all that it implies; and it goes without saying that this leaves much to be desired in Porto Rico. Time-honoured customs are difficult to change, and this form of conservatism is constantly levelled at the farming class all over the world; but what made their fathers successful will often no longer suffice, in the face of the many difficulties of present-day conditions. In regions of periodic rains in the tropics, connoting alternate wet and dry seasons, the question of the dust mulch comes prominently into view; and to get the full benefit of what rain falls, this must be seriously considered. This, it is pointed out, is well understood with other crops, e.g., the corn in the United States corn belt, and even cotton, although a drought resistant crop; both of these are so treated as to ensure its maintenance, and in Louisiana sugar cane is cultivated with the same care as corn. Why, in the West Indies, with harder and more compacted soils and the most capricious of rains, does the planter expect the cane to grow and yield full crops, year after year, without adequate tillage? The author finds this question difficult to answer, but tries to explain the anomaly by suggesting that the existing methods have come down unaltered from the time when cane was first cultivated on virgin soils. And the fact that these soils have, with the constant growing of sugar cane (a crop, by the way, practically always on the ground), changed their character and lost their permeability to air and moisture, is not yet fully appreciated. The sugar cane roots are specially susceptible to lack of air; when the soil becomes encrusted they quickly suffer, and are apt to be attacked by the fungi causing root disease, a condition entailing more losses than all the other cane troubles combined. It is this root disease which has caused so many of the old standard varieties to fail, and thousands of dollars have been lost through the running out of Otaheite, Rayada and Cristalina, all of which have in turn succumbed to root disease. And yet, this disease can be easily controlled by proper drainage, abundant manure and frequent tillage; and it is difficult to gauge the relative importance of these three. Properly attended to, the disease will disappear, and the extra cost will be more than covered by the greatly increased crops obtained.

More tillage is a necessity for securing full yields of cane on old lands: to conserve the moisture in anticipation of periods of drought, to aerate the soil and thus aid the penetration of gases so that healthy root development may take place, to keep up the vitality of the plants so that they can throw off the root disease, give the necessary growth condition for the beneficent bacteria which help in forming nitrates, to inhibit the harmful ones which, in the absence of oxygen, destroy the nitrates when formed, and so on. Some recent investigators, it is remarked, have gone further and claim that a first effect of tillage is to render plant food more easily available; so that, when moisture is short, less of it is needed for the same yield because the feeding soil solutions are stronger, and thus indirectly as well as directly saving water.

By tillage is meant any stirring of the surface soil between growing plants by implements. This may be done by hand hoe or rake; but the mere surface scraping done in hoeing in Porto Rico hardly earns the title because it does not break the surface crust. This is usually done more cheaply and efficiently by mules and horses, but the tractors are surely coming in, although thus far their use has not passed the experimental stage. As to the kind of implement used, this will depend on the nature and condition of the soil; but those found most generally useful are the 5-shovel cultivator, the 13-toothed harrow cultivator, the single shovel or Georgia stock with its various attachments, and the small 7-in. turning plough. And the use of these will also depend on the method of planting adopted; three such are used in Porto Rico, and the soil requires different treatment in all of them. These are briefly described by the author as follows :—

(1) The irrigated lands which are not low-lying and wet are mostly planted in what EARLE calls the *Hawaiian system*, first successfully introduced into the island at Central Aguirre. In this system the cane seed is placed at the bottom of deep furrows, which are laid out along the contour lines so to be more or less level; and they are crossed at intervals of 30 to 40 ft. by light furrows for bringing the water to the canes. If the planting furrows are arranged along the slope instead of across it, it becomes difficult to maintain the banks so as to confine the water, and this increases the amount of tillage needed. In such case the tendency has been to do as little tillage as possible and let the water alone make the crop. By using the Hawaiian method of level furrows, the author claims an increased yield of 20 to 25 per cent., as well as a saving of water. For working the soil he

recommends the harrow cultivator, placed at an inclination first on one side of the bank and then on the other. But this implement tends, after it has been used a few times, to pull the banks down; and it is then advisable to substitute the 5-tooth cultivator, after taking off the three front shovels and putting on, in their place, the broad hilling up wings supplied with it. This implement will restore the central ridge and hold the irrigated water. The single shovel or Georgia stock with a 16 in. hill sweep may now be used between the central ridge or bank and the plant rows, to clean up and open the water furrow. By alternating the use of these three cheap and effective implements, it is held that irrigated cane can be cultivated easily and effectively. It is, of course, specially necessary to follow up each irrigation or rain by a cultivation.

(2) Dry unirrigated uplands, where no extensive drainage is required, are best planted on what is known as the *Cuban system*, so called because it is widely employed in that island. Here too the cane seed is planted at the bottom of deep furrows, but these are arranged with just sufficient slope to carry off the flood waters. The furrows are gradually filled in by successive cultivations, until when the cane is laid by the surface is practically level. This is the simplest kind of cane cultivation. Single planting in continuous rows is recommended, as double planting or planting in holes leaves extra spaces, which take up much labour in preserving the surface tilth, presumably largely by hand work. Any of the implements mentioned above are fitted for cultivation in this system. If done frequently enough to destroy the weeds as they sprout, a 13-toothed harrow cultivator will be the only one required; and if care is taken to run it close to the cane plants hardly any hoeing will be necessary. When, however, continuous rain prevents cultivation till the ground becomes grassy, it will be necessary to to use either the double shovel or small turning plough, in both cases following with the harrow cultivator. It will pay to cultivate as often as once in 10 days, and sometimes more frequently still; aeration is the chief end in view, weed killing being a useful secondary benefit.

(3) All wet lands requiring drainage should be planted on the local *gran banco* system. Many Porto Rican lands are of this nature and this method, developed on the spot, meets the conditions admirably. In Louisiana, low wet lands are planted on top of sharp single-row ridges: the land is prepared as in the Cuban system, but the seed cane is placed on the top of the bank in place of the bottom of the furrow, which is kept open for drainage. This would not do for Porto Rico, for even such lands suffer from drought: in the *gran banco* system the ridges are made wide enough for two rows. The general practice is to make these banks by hand, but this is very expensive and usually there is no need at all for it. Most of these wet lands are dry enough for the plough at some time of the year, and the preparation can be done then. Deep ploughing is not needed, but the surface should be kept pulverized by successive harrowings: then the bank can be formed by a big turning plough giving two cuts in the same furrow, removing the earth as deeply as possible. When the furrows are cleaned by a double mould board plough or a Martin grader or both together, the banks will have been made. Then on each side of the bank a 7 in. turning plough is passed for making the planting furrows, and planting is again in single line. If a deep furrow is made for planting, then the space between the rows will be too narrow for working the soil. The top of the bank may be stirred by the harrow cultivator much as in the Cuban system. Meanwhile the ditches should be kept clean until they get set with grass. This can be done by a medium double mould board plough, such as is used in Cuba for the opening of the furrows, and much hand labour will be saved.

On very wet lands where there is constant standing water, the methods will have to be altered. It is better then to make the banks wider, up to 20 ft. across, thus giving room for four rows of canes, with deep permanent ditches made by hand between. These should be run in the direction of the natural drainage of the land, and after a time the banks will be dry enough for the soil to be worked by a small 8 to 10 in. plough. This plan is stated by **Earle** to be working well in practice.

It is obvious that in the three methods of cultivation recommended, water is the main factor to be considered; and presumably those described cover the main Porto Rican soils. Doubtless slight variations will be needed here and there, but if the necessary training is given to the local labour and these clear instructions are carried out, a great step will have been taken to remove the stigma at present attached to the plantation work in the island.

The instructions as to manuring are equally clear and convincing. Whatever method of planting is adopted, it is of great importance that this should be done, in the main, before planting, by placing at least 400 lbs. in the furrow. Thus a direct stimulus will be given to the roots to pass downwards, and a vigorous early growth may be considered as assured. As a contrast, later applications will have to be placed above the roots, inducing shallower development. After the cane is from 2 to 3 ft. high a second application may be applied at the side of the cane row, and it will be covered by the after cultivation, but this and subsequent doses cannot take the place of the first one at the bottom of the furrow. The author remarks that this cannot be too strongly insisted upon, as it appears to be little appreciated in the island.

Better cultivation is most urgently needed in the *ratoons*, because the condition of the ground has been spoilt by the trampling, especially during harvest operations: in the case of plant canes the preliminary preparation will have produced a thoroughly loosened and mellowed soil. The practice recommended is the lining of the trash on alternate middles, and letting it lie there as a mulch throughout the season, thus reducing the area to be worked by one half. Each row will thus get the benefit of the softening mulch on one side and the cultivation of the other. In *gran banco* however it will obviously be necessary for the bank to be first cultivated thoroughly, the trash being placed in the trenches until this is done, when it can be spread out over the pulverized soil. As soon as the trash is lined and before much root development can have started, the rows should be off-barred on each side of the cleaned middle, running a 10 in. plough as close to the canes as possible and throwing the soil towards the middle. The first dose of manure can be placed in the groove thus formed, in most soils passing a subsoiler to stir the soil and mix it with the manure. The harrow cultivator should immediately follow, breaking down the furrow slices and partly filling the grooves. After this the work will be upon the same lines as in plant cane: every ten days or two weeks an implement should be passed, and especially immediately after rains to prevent caking. The cost of the methods here outlined may not be more than that at present incurred, but there is little doubt that the yield will be largely increased, and above all root disease will be greatly decreased.

C. A. B.

At Wembley in the Barbados Court this year, Muscovado sugar, "the old fashioned sugar of childhood's days," is being sold in very attractive small packets, which, one cannot but help thinking would have a very good sale if available generally in the grocery trade in this country. Other exhibits at this admirable display besides various sugars are fancy syrup, molasses, rum, etc.

Cane Cultivation in the Philippines.[1]

Cane cultivation in Negros appears to have reached a more settled practice than in Luzon, which was referred to in a recent number of this Journal.[2] But, when describing the preparation of the ground, in both cases the clearing of the ground of bush and trees receives marked attention, from which we may safely gather that, even where sugar cane is concentrated to the greatest extent in the archipelago, virgin land still remains to be brought under the plough—a speaking comment on the enormous potentiality of the Philippines as a sugar producing country. In Negros the clearing is done in the usual way; where the bush is thin it is simply crushed by the disc harrow and ploughing follows; where it is dense, and larger growth is met with, this is cut down and left to dry before being burnt. The removal of roots is more economically done by contract; dynamiting is known, but is less effective because of the depth to which the roots penetrate, from which we might argue that the climate is dry, at any rate during a portion of the year. The cost of removal of the tree roots is given as ranging from 1 to 5 pesos (2s. 2d. each at par) per trunk.

Further preparation of the soil for planting is done either by *carabao* (water buffalo) or by tractor and, although the cost may in the two cases closely approximate, the latter is quicker and more efficient. Details are given of the cost per acre of this work and, although varying greatly according to the local price of a pair of *carabaos* per day and the type of tractor employed, may be taken at 8 to 12 pesos per hectare (2½ acres). This preparation consists of a series of ploughings followed by harrowings, the work being carried on at short intervals, dependent on the cloddy state of the ground, the rapidity of weed growth, and the weather. A slight economy is said to be gained by removing one of the (usually four) discs, and hitching the harrow on in its place, thus performing the two operations at the same time. Where *cogon* (*Imperata arundinacea*) is present, this has to be entirely removed before planting, or the costs of after cultivation will be seriously increased and the crop of canes diminished. For this work the tractor is preferred. But here again care has to be taken not to interfere with the subsoil; and it is recommended that, to obviate this, which is less likely to occur with the native animal implements, the depth of ploughing should be only gradually increased during the season and through successive years. The preparation aims at producing an even surface, the soil being thoroughly stirred and with a fine tilth to keep the moisture from being lost before and after planting. The methods described appear to be thoroughly effective, and if universally carried out leave little to be desired.

Seed Cane.—The planting material appears to consist almost entirely of tops, called locally "points," which may be defined as the upper 6–8 ins. of the cane stalk freed from its leaves; and because of the climate their preparation appears to receive a great deal of attention. Usually only one point is obtained from each stalk, but in the case of unripe canes or those planted for seed purposes two or more may be used. Some think that if the cane is not more than halfway to maturity (i.e., six months old, or in Badila and H 109 seven), the whole cane may be planted during rainy periods. These take longer to germinate, but the roots develop more quickly, the cane seed is less liable to disease and stands the rains better. The points are generally obtained from the canes to be milled; the point cutters proceed to the field before the cane cutters, and with curved knives sever the tops while holding the canes by their upper leaves. When five or six have been collected (as many as can be conveniently held by the hand) they are placed in a heap at the side of the field. After a certain number have been thus collected, the leaves are cut off by a sudden blow and reserved for the animals. The points are then covered with dry leaves till carried away by carts. A good cutter will prepare 5000 in a day but the average is a good deal less; the rate of payment varies from 2 to 2½ pesos per *lúcsa* (10,000). Points cut in the morning should have their leaves separated at midday, and those collected in the afternoon before night. This is to minimize evaporation and if neglected will mean weak or shrunken points. When prepared, the points are carried on carts (3000 to the load) to the soaking tanks or some small river if the weather is dry, and to the fields direct if it is moist. The water used should if possible be clear, and the points should remain at least 24 hours in soak. Germination is stimulated by covering the points in a pile for another 24 hours after soaking.

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[1] Cultivation of Sugar Cane in Western Negros. C. L. Locsin. *Sugar News*, Vol IV, No 10, October 1923 to January 1924.

[2] *I.S.J.*, 1925, p. 244.

Planting.—In the plains of Negros planting takes place between November and March, and there are well-marked dry and wet seasons, where the core of mountainous country acts as a dividing line: the rains commence between May and July. The main condition influencing the time of planting is that the canes should have time for growth, so that they close in before the advent of the rainy season. This begins earlier in the southern part of the island, and planting takes place between November and January; in the north, on the other hand, where the rains come later, planting need not be done so early, January being the favourite month. But another factor has to be considered, namely, the presence of *tamasoc* (known in some other countries as "dead hearts"). This is more prevalent in the earlier half of the planting period. Thus there are two opposing factors: the necessity of ensuring as rapid early growth as possible and an avoidance of this pest. The north has obviously the advantage in this matter. In the hilly regions and certain favoured localities (the districts of Victoria and Manapla, where presumably the chain of mountains is broken), the rains are fairly well distributed, and planting may be done at any time. But *tamasoc* may here appear at any time also and, furthermore, is apt to appear several times in succession in the same field.

The following are the characters of this infestation. Shortly after the shoots of the young cane appear above ground, they begin to wither and die all over the field. When pulled, the affected shoots come away in the hand, and their bases are seen to be rotting, with numerous small worms moving about in the putrid mass. These were at first thought to be the casual agent, but a more careful study showed them to be, as elsewhere, merely of secondary importance. The real culprit was found to be a small moth, *Emmalocera depressa*, which had been noted and described in India. The eggs are laid on the leaves and the half-inch grubs pass down the outside of the shoots to below the surface of the ground, where they tunnel directly to the heart and cut the young leaves across, thus killing them. As in some other countries, the planters regard the infestation with a certain amount of unconcern, in that they consider that the damage done is counterbalanced by an increase in tillering, but there is little doubt that the checking of growth in the local circumstances is a serious evil, especially in the regions of more favourable rainfall, where the attack may be repeated again and again, and of course in the south of the island, where early growth is specially desirable. Various remedies have been advocated from time to time, from the pulling out and burning of the dead hearts, thus diminishing the numbers of insects (which moreover mature rather slowly before passing to other shoots), to collecting the moths in heaps of cane trash where they hide during the day and can thus be collected and burnt at intervals, and, lastly, the encouragement of an egg parasite (*Trichogamma*) which is widely distributed. A species of this parasite has been found in the Philippines. The local custom among the planters is to uncover the bases of affected plants, not so much it is said to expose or kill the wandering grubs as to encourage tillering. For the sake of the egg parasite we doubt the advisability of burning the trash as mentioned below.

When the fields are thoroughly cleaned and the soil is in a fine physical condition, furrows are opened, preferably by a short mould board plough which goes deeper than the American. Commonly two turns of the plough are made, but three to four are considered better, as giving more root room, especially where ratooning is practised. The most skilful ploughmen are employed for this work so as to get the furrows straight and at regular distances apart; and it is good practice to supply them with measuring rods, which can also be placed at the end of the furrow to give a line. The direction of the furrows varies with the opinion of the planter: some prefer north and south, or in the direction of the wind, as making it cooler for the cattle; while others place the furrows east and west to get the soil more sunned and to penetrate deeper beneath the leaves. In cases of fields sloping down to low land, the latter is first dealt with, because it takes longer to dry. The distances apart and in the rows also vary with opinion; also as to whether single or double planting is adopted. In the latter case the plants are 18 to 20 ins. apart and the rows 4 to 5 ft., in the former, 8-12 ins. and 3 to 4 ft. (20,000 to 30,000 points per hectare). The tendency is to plant in double row, so as to ensure at any rate one plant. On the whole wider spacing is preferred, because the cultivation is easier, the sun's action is retarded and soil moisture conserved. Planting is done by women and costs from 2 to 2½ pesos per lacsa (5 to 6 pesos to the hectare). An expert woman will plant up to 3000 points per day. The points are husked by the planter for two-thirds of the distance from the base, the upper part remaining protected. In actual planting earth is collected by both hands from the sides of the furrow, and the point is pushed into this at an angle of 45°: then additional earth is heaped around. Changing seed cane from one locality to another, especially where there are differences in climate, elevation and soil, is considered beneficial, as decreasing the tendency to deterioration. Machine planting is not in vogue, possibly because flat planting is not the fashion.

Cultivation.—Under this term (often distinguished as after-cultivation) is included all field work, from the moment the cane is planted till it finally closes in, when all operations perforce cease. The local implements are the small *carabao* plough, the harrow (*pacalas*), hoe (*sadol*), which need not be described, and the *guna*, a small iron shovel made in one piece, 8 in. long over all with the blade 3 in. wide. The whole system of operations aims at removing the weeds, preserving the surface mulch, encouraging the shooting and tillering of the stools, preventing the accumulation of water after heavy rain and, lastly, at once breaking the hard crust formed when the latter is followed by hot sun. No mention is made of manuring. These operations, as regards the cane rows, consist essentially of an alternating series of throwing the earth to the cane rows (*pasandiq*) and removing it again by the reverse process (*pahulug*). Where a crust is formed soon after *pahulug*, the two operations are repeated in quick succession and are then called *hulu-pasandig*. When either *pasandig* or *pahulug* is performed, the interspaces are cultivated by passing the plough or harrowing. It must be admitted that this practice, if faithfully followed through, could not be improved upon.

After planting, the field is allowed to lie till the first weeds appear, which occurs in the lowlands after two to three weeks and in the higher lands after three to four. Then *pasandig* is performed, care being taken not to completely cover any of the young shoots appearing above the surface: with four to five ploughs a hectare can be dealt with in a day. Two to three weeks later the weeds will have appeared again and commenced to flower; then *pahulug* is done, the earth being removed by the ploughs from the cane rows. And here two opposite practices are followed, according to the local opinion and the character of the soil. In the first of these the plough is run about 2 to 3 in. from the stool to avoid cutting the young roots, while in the second it is worked as near as possible to them with the object of trimming them. It is held by the author that the former method is preferable, in that to cut the roots at this early stage of growth tends to check the desirable rapid growth of the young cane: and that this takes place is evidenced by the stiffening of the leaves after the operation. The advocates of the second method claim that pruning the roots will stimulate growth and that it aids in their development, stirs the earth and prevents hardening of the soil around them. The author allows that in heavy clays, which are specially liable to form a hard crust if heavy rain is followed by hot sun, the practice may result in ultimate gain, especially if the roots are not cut too deep.

After this removal of the earth from the stools, the rows are cleaned by hoes or shovels, the smaller implements being preferred among the actual shoots. In many cases this operation is relegated to women and children, who are taught to get out the roots of the weeds carefully, if necessary by hand pulling. The cost of weeding in ordinary circumstances works out at 5 to 6 pesos per hectare. The spaces between the rows are then harrowed, and the field again allowed to rest, till the shoots have grown and the weeds appear again. Before they reach the flowering stage the earth is thrown back; and this system of cultivation is repeated till the canes are ready to close in. If the land is very fertile and the conditions for cane growing favourable, one to two weedings will ordinarily suffice, but if the cane growth is weak three to four will be needed. In the lowlands the canes will begin to close in between May and August; and in good practice this will be completed at any rate by the latter month. The last earthing up is somewhat greater than the preceding ones, and for this purpose some planters make use of the *guna*, as by it any hollows between the shoots or stools can be readily filled in. The main points to be held in view are: avoiding covering any young shoots which have appeared, maintaining a loose earth mulch and avoiding the stagnation of water or forming of a hard crust, never allowing the weeds to seed, and if possible not to work in the fields in wet weather. There is no need for earthing up too high in the last act, and when *tamasor* is prevalent it is advisable to leave the stools open and uncovered as long as possible.

Ratoon cultivation.—The first operation is to burn the field over. Then with well sharpened hoes the stubble is shaved, at the same time drawing the earth away from the banks into the trenches, so as to leave the field even and smooth. This will prevent any great evaporation of the moisture "attracted to the surface by the burning." If these operations are well carried out germination will be uniform throughout, but otherwise it will be irregular. The ratoons are then allowed to grow undisturbed till the shoots are 12 to 20 ins. high, when *pahulug* is performed by ordinary ploughs: then the interspaces are harrowed and this is followed by *pasandig*. The remaining cultivation is as in plant canes, excepting that the roots must not remain uncovered for long after weeding, as ratoons are more superficial than plant canes and are injuriously affected by water or hot sun. For the same reason the furrows in which the points are planted should be deeper in all cases where ratooning is intended.

Stubble shaving requires a large labour force, and this is sometimes unavailable because of harvesting. In such a case it is advisable to *pahulug* at once, passing the coulter as close as possible to the stools to cut the old roots and leave space for the fresh ones. At the same time the earth between the rows is broken up, cutting the roots there too and loosening the soil. Both this operation and that of stubble shaving cost more than weeding, and usually work out at from 8 to 10 pesos per hectare. In regions of well distributed rain, because of drainage and wash, the ratoons are kept hilled up most of the time. In this case, besides *pasundig* with the plough, labourers hill up with hoes and shovels.

C. A. B.

The Sugar Industry of the Indo Gangetic Plain.

By an Occasional Correspondent.

The Indo Gangetic Plain for the purposes of this note refers mainly to the United Provinces of Agra and Oudh, and to that portion of Behar and Orissa which lies north of the Ganges. The whole area under consideration lies roughly between the parallels 24° and 28°N and 82° and 87°E. It is therefore wholly extra tropical and in this respect compares with Louisiana, Argentina, Egypt, and Natal.

The magnitude of the industry in India is frequently overlooked; in all in India little short of 3,000,000 acres of sugar cane are annually planted, of which 1,500,000 or thereabouts are contained in the United Provinces and 300,000 in Behar and Orissa. Of the balance 400,000 acres will be found in the Punjab, 200,000 in Bengal, 100,000 in Madras, and 100,000 in Bombay. The other divisions of the Indian Empire contribute much smaller areas.

Historically this area is of great interest forming in common with two other great river systems the Nile and the Euphrates-Tigris, the localities whence have originated much of our present religious and philosophical ideas.

It was in this Indo Gangetic Plain that Sakya Muni or Gotama, usually referred to by Europeans as Buddha, was born about 550 B.C. at Kapilavastu not far from Uska Bazar. At Gaya he received his revelation, and perhaps died at Kasi, about 30 miles from Gorakhpore. It was in this area too that the great Maurya dynasty ruled, with their capital at Pataliputra (Patna) from 321 to 200 B.C., and whence Asoka promulgated those remarkable moral edicts graven on rocks and pillars of stone, many of which stand erect to-day. Three such pillars remain to-day in Behar, all close to the East bank of the Gondak. They are by some scholars believed to mark the spots where Gotama rested and taught on his last journey. If this supposition is well-founded he must have passed close to the sites at present occupied by the mills of the Champaran, Pursa and United Provinces Sugar Companies (*9*, *10* and *11* on the accompanying map).

It was in this area also that Gotama's great contemporary, Mahavira, organizer, if not the founder, of the Jain religion was born at the city of Vaisali, the site of which has been placed at Saraya some 18 miles from Muzafferpore; and it was here too that at least one General Council of the Buddhist Church was held.

As indicating the great antiquity of sugar cane culture in this area it is only to be remembered that the Sakya clan had adopted the sugar cane as their badge, and indeed the opening verses of the Chinese canon of the Buddhist scriptures run:—

"There was a descendant of the Ikshvaku (i.e., sugar cane) family, an invincible Sakya monarch" referring to Suddhodana, the father of Sakya Muni. And again in the Institutes of Manu VIII, 341, perhaps composed at a yet earlier period there appears the passage '(A twice born man who is travelling and whose provisions are exhausted shall not be fined if he take two stalks of sugar cane and two roots from the field of another man.')

Probably then it would be no exaggeration to attribute to this area an uninterrupted period of sugar cane cultivation of not less than 3000 years.

At a later date Behar must have obtained some fame as a progressive sugar producing area, since records exist that about 600 A.D. the Chinese Emperor Tsai Heng sent agents to Behar to learn the art of manufacture of sugar, thus perhaps forming the first instance on record of a technical commission investigating manufacturing processes in a foreign country.

From these early times down to the present day sugar cane has always formed one of the staple crops of this area although it is only in comparatively recent times that European capital has been invested. The Honourable East India Company showed an interest in developing trade in sugar in the latter part of the 18th century and an exhaustive report was issued in 1792. There does not appear to have been any outcome of the report, and it was not till about 1840 that any attempt was made to establish an industry. At this time there appeared in Behar a Mauritian Planter, **Robinson** by name, and presumably the author of a work "The Bengal Sugar Planter." A number of factories were started but none ended in success. A lampoon of the time thus describes the failure.

"The Sugar King stretched out his hand,
Talked of the cheapness of labour and richness of the land,
Of twenty maunds a begah.
Take cypher from the nought, divide the tèn by two,
The result will be the product exceeded but by few.
Then things went on right jolly
Till the district was dotted over with monuments of folly."

Another brochure of the time describes a planter travelling by boat up the Gondak, his cargo consisting of two boilers in one of which the planter lived, the other being occupied by a bear. It is recorded that the bear arrived safely but that the boilers did not.

Judging, however, from "The Bengal Sugar Planter," **Robinson** was a man of parts and his ideas of sugar manufacture were well abreast of the times. The factories he advocated and described in his treatise would be considered for that period thoroughly well equipped. It is interesting to note that vacuum pans were constructed by **Jessop** & Co. in Calcutta previous to 1849.

A new start was made very early in the present century, and was directly stimulated by the decline in indigo prices when a factory was established at Ottur by the India Development Co. This enterprise did not meet with success, but it was shortly followed by others at Japaha, Pursa, Marhowrah, Barrah and Purtabpore, all of which remain and operate to-day as successful concerns. At first these factories were of very modest size, being designed for 200 tons of cane per day and were equipped with only 8-roller mills, and although the size has not much increased it will be seen from the annexed tabulation that the equipment has been materially improved.

Extent of the industry.—In all there exist in Behar and the United Provinces 18 central factories, the positions of 16 of which are shown in the accompanying map. The two not shown, Rosa and that of L. H. Brothers, being about 120 miles north-east of Gondak and close to Bareilly. Details of the equipment and capacity of these factories are given in tabulated form below. Compared with the factories of Cuba, Java, and Hawaii, their capacities are very modest and although the equipment still leaves much to be desired in many cases, certain factories are well provided with machinery.

Allowing 120 working days to a campaign, the united capacity of all the factories scheduled would amount to about 750,000 short tons of cane; so great a quantity of cane has never yet been milled in one year and 350,000 tons or thereabouts is the most which has yet been achieved.

Source of cane.—The total tonnage of cane in the area under discussion will in a year of favourable monsoon amount to 20,000,000 tons, and of this by far the greater portion is grown by ryots or peasant proprietors in small holdings. These proprietors are quite independent of the factories and have full liberty to sell their cane or manufacture it into gur, and actually not as much as 3 per cent. of the total quantity grown finds its way to the central factories.

Apart however from the ryot, there are mainly congregated in the districts of Champaran and Darbhanga some thirty-odd European-owned concerns which provide the major portion of the raw material to the Samastipore and Champaran centrals. Two other of the centrals, Japaha and Purtabpore, combine cultivation on the large scale with manufacture, and savour somewhat of the typical old time West Indian plantation. The part played by the European planter in cane production is however small compared with that due to the indigenous tiller of the soil, and those that remain may be regarded as the rearguard of the once numerous and wealthy army of Behar planters.

Transport.—Reference to the map on page 531 will show that nearly all the centrals are located on one or other of the lines of the Bengal and North Western Railway; the development of the modern sugar industry could not have materialized in the absence of a railway system. The transport of cane to the factories is, however, dependent on bullock cart haulage as feeders to the railway, and in addition much cane is carried directly to the mills by bullock cart. The limit of this slow but certain method of transport is about 10 miles, whether as feeder to the railway or direct to the factory.

Although no statistics are available, it may be estimated that 45 per cent. of the cane which reaches the centrals arrives directly in carts and 55 per cent. is transported by rail after being delivered to loading stations by cart. During the cold weather but little difference is noticeable as between cart and railway cane, but as the temperature rises deterioration in transit of railway cane is readily to be detected, especially when the length of haul reaches 50 miles and more.

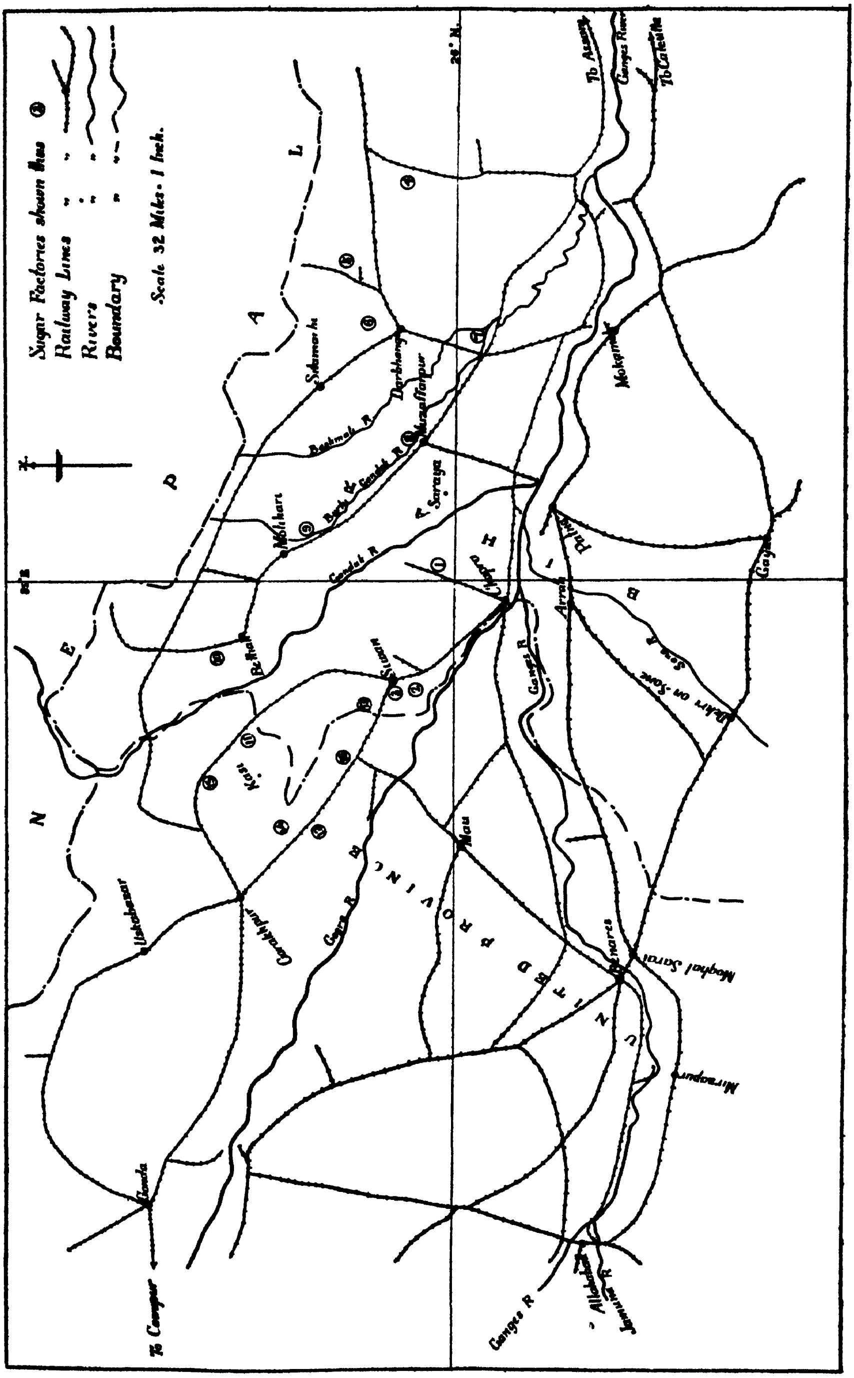
The Bengal and North Western Railway is a metre gauge system and the average cane load of a waggon is 16,000 lbs. The waggons supplied are of such construction that unloading is necessarily performed manually.

The Bengal and North Western Railway is not connected directly with the East Indian Railway which runs south of the Ganges. All material from European ports landed at Calcutta has to be transshipped at Makameh Ghat and ferried across the Ganges, as also has the limestone used in carbonatation factories, the source of this being quarries at Dehri-on-Sone. This break of gauge leads to vexatious delays and losses in the transport of machinery and supplies.

Varieties of cane grown.—What is known of the varieties of cane grown in Northern India is mainly due to C. A. **Barber** who has unfortunately retired

FACTORIES.	Reference in Map	Capacity short tons cane per hour.	Number of rollers.	Evaporators.	Process.	Suppliers.
Cawnpore Sugar Works, Marhowrah	1	20	14	Triple	Carbonation	Harvey Engineering Co.
Behar Sugar Works, Pachrukhi	2	20	11	Quadruple	,,	Maschinenfabrik Grevenbroich.
New Savan Sugar Factory, Savan	3	15	12	Triple	Sulphitation	—
Behar Sugar Co., Sepaul	4	10	8	,,	,,	—
Darbhanga Sugar Co., Lohat	5	25	8	,,	,,	Mirrlees Watson Co.
Ryam Sugar Co., Ryam	6	20	11	,,	Carbonation	,,
Samastipore Central Sugar Co., Samastipore	7	20	14	,,	Sulphitation	Mirrlees Watson and Blair, Campbell & McLean, Ltd.
Japaha Sugar Factory, Japaha	8	15	8	,,	,,	Harvey Engineering Co.
Champaran Sugar Co., Chakia	9	25	17	,,	Carbonation	,,
Pursa Sugar Factory, Pursa	10	15	11	,,	Sulphitation	,,
United Provinces Sugar Co., Tumkohi	11	20	11	,,	,,	,,
Cawnpore Sugar Works, Gauri Bazar	12	10	14	,,	,,	Mirrlees Watson Co.
Purtabpore Sugar Factory, Purtabpore	13	20	11	,,	Carbonation	Harvey Engineering Co.
Saraya Sugar Factory, Chauri Chaura	14	10	8	,,	Sulphitation	—
Padrauna Raj Krisna Sugar Works, Ltd., Padrauna	15	15	8	,,	,,	Harvey Engineering Co.
Bhatni Sugar Factory, Bhatni	16	25	11	,,	,,	,,
L. H. Brothers Sugar Factory, Pilibhit	—	?	?	—	—	—
Rosa Sugar Factory, Shahjehanpore	—	?	?	—	—	—

The Sugar Industry of the Indo Gangetic Plain.



before his studies were complete. He has separated the canes of Northern India into five classes, Mungo, Seretha, Sunnabile, Pansahi and Nagori. His studies deal mainly with the Seretha and Sunnabile classes as they are found in the Punjab, where they apparently form the predominant types. In Behar, north of the Ganges, and as far west as Gorakhpore, the dominant canes grown belong to the Mungo group.

Three types occur, distinguished by the names Hemza, Bhurli and Rheora. These varieties are very close to each other, and the names become interchanged from district to district, what is called Bhurli in one village being named Hemza in another, and the three varieties are certainly much intermixed in the ryotti cultivation. They are described by **BARBER** as of a dwarf bushy habit, but under superior conditions the dwarfness tends to disappear, though the bushy habit is always very pronounced in young cultivation.

These canes are of medium diameter and of pale green colour, becoming yellow tinged with pink where sun exposed.

In the north-east of Behar and especially in the vicinity of Sitamarhi, adjacent to the Nepal Frontier, large areas are laid down in canes belonging to the Nagori group. The canes are of narrow diameter, very fibrous and with swollen nodes. They have the characteristic of thriving in swampy land, and may often be seen growing in the same field as rice. They ripen, or at least afford a juice of high sugar content, as early as October when it is customary for the ryots to begin their harvest. This early harvest is connected with the Chat festival which demands in its ceremonies freshly made gur. The varieties distinguished are Nagori, Sewari, Kewali, Hathoopi, Haruki and Baruk, the latter name merely meaning swamp cane.

Barber's Pansahi group is represented fairly extensively by the Chinia cane which is also grown in low-lying land and is very close to the Uba cane which has lately been so prominent.

From time to time introductions of the traditional varieties have been made but no one has ever succeeded in becoming established on the extensive scale. A thick red cane known as Australian or Maxwell after its introducer is grown to some extent by a few European planters.

South of the Ganges different types of canes more nearly approaching the noble canes are cultivated. One variety in particular, Puri, in fairly extensive cultivation has nothing to differentiate it from a noble cane in the layman's eyes.

Recently following on the cane breeding work of **BARBER** and **VENKATRAMAN**, and on the efforts of the Sugar Bureau under the direction of **WYNNE SAYER**, various hybrid seedlings have been introduced and have become extensively planted with a great measure of success. These are:—

Coimbatore 210, a seedling from P.O.J. 213, the probable male parent being either M 2 or M 1017, two Madras seedlings.

Co 213, a seedling from P.O.J. 213, the probable male parent being Kansar or possibly M 2. Kansar is a cane belonging to Barber's Saretha group.

Co 214, a seedling of striped Mauritius, the male parent being probably a cross between Saretha and *S. spontaneum*.

As the parentage of P.O.J. 213 is Chunnee × Black Cheribon, these canes have a very interesting ancestry.

Composition of the cane.—Systematic routine observations over a group of six factories afford the following data, which refer mainly to the Hemza variety and its congeners:—

	Sugar per cent.	Fibre per cent.	Purity first mill juice
1922-23	12·20	14·38	82·67
1923-24	11·63	13·81	78·94
1924-25	11·63	14·63	79·83
Max. of one factory	13·00	11·80	83·99
Min. of one factory	10·18	15·14	74·17

These data refer to the material as received at the carrier and to the composition as worked backwards from the factory records, and not as obtained from. direct analysis of the stalks. The behaviour of the cane during the harvest is precisely the same as observed elsewhere in similar latitudes, i.e., from December onwards the sugar content and purity increase reaching a maximum in March and April after which time a slow decrease is observed. At the period of maximum sugar content the cane may occasionally contain as much as 15 per cent. sugar, with a purity in first mill juice of 88.

Factory yields.—With an average sugar content of 11·6 in cane and a properly equipped and efficiently operated factory, a yield of 9·5 per cent. in white sugar should be obtained. A yield of over 9 per cent. has however been obtained by only two factories in India, and the return consequent on inefficient manufacture and defective operation is much less.

For the year 1924-25 a certain group of factories reputed to be the least inefficient in India obtained a yield of 8·69 per cent. with a maximum yield in one factory of 9·70 per cent. The average yield in all other factories outside this group was about 6·5 per cent. with a maximum of 8·00 per cent.

Climate.—The area under review presents characteristics of climate found in few other cane producing areas. It is remarkable for intense heat in summer reaching up to 100°F in the shade, and for a cool winter, when the temperature exceptionally falls to 32°F. The monsoon is usually expected to break about the middle of June and continue to the end of October. During this period as much as 65 inches of rain or as little as 15 inches may fall, the average being about 45 inches. Isolated rainfalls also occur not infrequently in the cold weather from December to February, and the submontane areas may be visited by heavy local showers at any time.

Cane growing under these conditions is somewhat hazardous and the promise of an excellent crop may be falsified by a late monsoon, and on the other hand an established crop may be severely damaged by excessive late rains resulting in floods. These floods often are not consequent on precipitation in the cane growing areas but follow on falls in the submontane districts.

A peculiarity of this area is the hot west winds which commonly blow from mid-March onwards till the break of the monsoon towards the end of June. These winds having passed over the arid desert regions of the North West are of low humidity and cause drying up and wilting of standing cane. During the period that they blow, their effect in causing deterioration of cane in transit can easily be seen in factory records.

Soils.—The soils of this area under consideration have not been so extensively surveyed as have those of other great sugar producing areas. From casual inspection they would be classed as sandy loams, and differences can be observed dependent on whether the soil has been influenced by the deposit from the Ganges, the Gandak, the Gogra or other of the rivers flowing South East from the Himalayas. Soil types influenced by smaller rivers such as the Bagmati are often well defined, as some of these, when in flood, appear to bring down a deposit distinct from that afforded by the larger rivers.

The most detailed account of Behar soils is that due to **Davis** mainly in connection with indigo research, and his analyses indicate that the soils are amply supplied with lime, have a good supply of potash, but are deficient in nitrogen and phosphate. Typical analyses of a Behar soil would be, following Davis' analyses:—

	Total per cent.		Available per cent. (Dyer's method).
Lime	10 — 25		
Potash..	0·3 — 0·8	....	0 004 — 0·1
Phosphoric acid	0 04 — 0.1	.	Trace — 0·005
Nitrogen	0·02 — 0·1		

Going westward towards the United Provinces the percentage of lime falls and the available phosphoric acid increases.

Diseases.—A full account of the diseases of the sugar cane mainly as they affect the Indo-Gangetic plain is to be found in Dr. **Butler**'s "Fungi and Disease in Plants." The most widespread disease which the layman can readily recognize is the Red Rot (*Colletotrichum falcatum*).

The present writer has had extensive opportunities of examining cane delivered to central factories and it seems to him that Red Rot is far more prevalent in the Western portions of the Indo Gangetic Plain than in the Eastern. Some extensive areas seem nearly free and the correlation between sugar content of the cane and absence or presence of Red Rot is remarkable. Every year, however, much material damage occurs from this fungus, and in certain areas it would appear that the whole crop and soil is infected so that healthy cuttings for seed are unobtainable.

There are also indications to be found in examining canes selected from the carrier that Wilt (*Cephalosporiun sacchari*) and Collar Rot (*Hendersonina sacchari*) are also present, judging merely from the microscopic appearance of the interior of the affected cane. In such cases an intensely red coloured juice is obtained, the red coloration with the sulphitation process persisting in the crystals of sugar.

Of the leaf spots the Brown leaf spot (*Cercospora sacchari*) is easily recognized, and it appears to be more prevalent during prolonged spells of wet weather. Fields may often be observed where the leaf surface immobilized by this fungus forms a notable percentage of the whole.

Apart from these diseases Mosaic is widely spread all over Northern India. The writer suspected this condition from his first sight of cane fields but avoided expressing an opinion until he had had the expert opinion of cane specialists to whom he sent suspicious specimens. The unrecognized overhead loss in Northern India due to Mosaic is probably very great, and being unrecognized and accepted it has not up to the present been accorded concerted prophylactic action.[1] The variety mainly grown, Hemza, should possibly be classed as tolerant to this disease. Notwithstanding, the endemic presence of Mosaic would appear to the writer as a major contributory cause to the habitual low yields obtained in the Indo Gangetic Plain.

Insect pests.—The insect pests of Northern India have been described in detail by Maxwell Lefroy. Most noticeable of all are various moth borers. Top, stem, and basal borers, are noticed and collectively much damage is done. The most frequent of these is the white top borer, *Scirpophaga auriflua*, and following on this the root or base borer, *Polyocha saccharella*. As elsewhere while considerable areas in one location may be damaged other adjacent areas may escape. Other common pests recognizable by the amateur include a plant louse, a leaf sucking hemipteron, and a small beetle which attacks the very young cane shortly after germination. Apart from the moth borers the most serious pest is probably the white ant, which, especially before the monsoon breaks, will destroy large number of cuttings.

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[1] This extensive occurrence of Mosaic in North India is news to us —Ed.

Cultivation.—Generally in Behar and the United Provinces cane is not grown on the same land more than once in four years, and it is only exceptionally that a ratoon crop is taken. The land in the interval may be occupied by pigeon pea, tobacco, chillies, and various grains and leguminous crops. Preparation of the land is performed with a wooden plough tipped with iron and drawn by a pair of bullocks. After numerous ploughings the land is rolled and levelled and generally a superfine tilth is obtained. The cane is planted on the level and not in trenches. Very close planting is common and about 10,000 three-node cuttings will be used to an acre. After planting but little further work is done by the ryot.

On the European owned concerns, tractor ploughs and implemental cultivation are common, and the operations here have more in common with Western methods. Indigo still is grown in rotation with cane on certain of these plantations, and green manuring with sun hemp (*Crotalaria juncea*) is common practice. It is a matter of regret that the indigo industry is moribund, as this being a legume provided a valuable rotation crop for cane.

Irrigation.—In Behar, that is to say the eastern portion of the area under review, irrigation of the cane is very little practised by the ryot. In the more westernly portion, i.e., in the United Provinces of Agra and Oudh, cane is regularly irrigated, the water being manually lifted from shallow wells by the Jungla or Paicota. This consists of a beam pivoted on a pole, to one end of the beam being attached a bucket, the operator pulling at the opposite end of the pole. Such a means may irrigate laborously half an acre of cane. On the European-owned concerns irrigation is occasionally practised but only as a means of saving the cane crop consequent on a late monsoon. The idea of irrigation is entirely protective, and intensive irrigation independent of and in conjunction with the monsoon for the production of the maximum tonnage from a given area does not seem to obtain. One concern. however, has lately put down a scheme on the intensive idea, but with what economic result is not yet known.

Yield per acre.—For the season 1922-23 the official departmental statistics give:

	Acres.	Tons Gur.	Cane per Acre, Tons.	Gur per Acre, Tons.	Gur per cent. Cane.
Behar	3,073,000	3,186,750	10·3	1 03	10
U.P.	1,543,902	1,629,000	—	1·06	—

These yields are probably the smallest in the world, and with so poor an agricultural yield it is a matter of surprise that an industry of such magnitude can exist. These yields reflect the inadequacy of the cultivation methods pursued by the peasant proprietor, for yields much in advance of these are regularly obtained on the best managed of the European-operated concerns. With the newly introduced canes of the Co series, yields of 35 tons per acre have been obtained on an extensive scale, and with systematic irrigation combined with proper manuring and cultivation, there does not seem any reason why an average of 25 tons should not be realized.

The gur industry apart from the sugar industry.—It will be readily seen that the sugar industry forms a very small proportion of the whole cane-growing industry, and of the total of 18,000,000 tons of cane produced in the Indo Gangetic valley not more than 2½–3 per cent. on an average is handled in modern factories. This phase of the industry may perhaps be discussed in a further communication.

Soil Hygiene in its Relation to Cane "Disease.'

By **MAURICE BIRD, B.Sc.**
Berbice, British Guiana.
[*Second Communication.*]

As the withering of cane (of which I wrote under the above heading in the August issue of this Journal[1]), continued in isolated cases, the following investigation was planned for two estates and carried out on each estate absolutely independently of the other.

Samples of withered cane were taken from fields showing it, and samples were taken from fields showing no trace of it, on each estate. These samples were divided into roots, stalks and leaves, and the resulting twelve samples were cut up as finely as practicable, and, after drying, burnt to ash. The lime and magnesia were then determined in each sample, and the lime ± magnesia ratio calculated. Simultaneously the soils from which the canes had been taken, were analysed, each estate doing the work in its own laboratory with the following results:—

LIME AND MAGNESIA IN ASH OF "WITHERED" AND "GOOD" CANE AT "P.M." AND "R.H."

	Estate	Roots	Stalks	Leaves.	Date Harvested.
Withered Cane.					
Lime per cent. of the Ash	P.M.	1·60	3·62	3·13	11-7-25
	R.H.	0·48	1·22	2·05	28-3-25
Magnesia per cent. of the Ash	P.M.	2·12	7·70	2·66	11-7-25
	R.H.	1 26	5 44	2·12	28-3-25
Ratio of Lime to Magnesia	P.M.	1 : 1·3	1 : 2·1	1 : 0·84	
	R.H.	1 : 2·6	1 : 4·4	1 : 1·0	
Good Cane.					
Lime per cent. of the Ash	P.M.	1·10	3·13	2·01	13-7-25
	R.H.	0·52	1·88	2·52	2-5-25
Magnesia per cent. of the Ash	P.M.	0·97	7·54	2·63	13-7-25
	R.H.	0·81	6·55	2·61	2-5-25
Ratio of Lime to Magnesia	P.M.	1 : 0·88	1 : 2·4	1 : 1·3	
	R.H.	1 : 1·5	1 : 3·4	1 : 1·0	

Compared with analyses compiled and quoted by DEERR, GEERLIGS and SPENCER, the lime in the above analyses of ash is strikingly low throughout, not only in relation with the magnesia present, but in its total actual amount as a percentage of the ash.

Also the predominance of vegetable matter in those fields which produced no withered cane was very obvious from the colour; and still more so when the soils were shaken up with water, comparatively large quantities rising to the surface; whereas, in the case of the grey clay producing the withered cane, little or no vegetable matter was to be seen, when this soil was similarly treated.

From this, I conclude that the organic matter kept the soils of the last two fields loose and porous, permitting a flow of lime in solution to the roots, and so prevented the dire need of it by the plant.

When this agency failed, as in the grey clay, to keep the soil channels sufficiently permeable, the supply of lime was not sufficient for the vigorously growing crop, and withering and death of the cane then ensued.

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[1] *I.S.J.*, 1925, 423-424.

ANALYSIS OF THE SOILS UPON WHICH THE ABOVE CANE WAS GROWN.

				Ingredients soluble in a 1 per cent solution of citric acid, per cent. soil.					
Estate.	Field.	Description.	Volatile matter, per cent. soil.	Lime.	Magnesia.	Ratio, Lime to Magnesia	Potash.	Soda.	Phosphoric Acid.
Withered Cane.									
P.M.	Tain Windward 26	Grey Clay	13·64	0 077	0·029	1 : 0·37	0·017	0·113	0·003
R.H.	B.D. 15	Grey Clay	16·47	0·043	0·032	1 : 0 74	0·029	0·024	0·003
Good Cane.									
P.M.	Ank. O.G. 15	Dark Grey Clay	14·52	0·082	0·014	1 : 0·17	0·018	0 055	0·005
R.H.	Canefield 33	Dark Grey Clay	17·02	0·035	0·019	1 : 0·54	0·019	0·005	0 005

The withering of the cane is, therefore, not so much a menace of disaster, as a curtailment of the yield, when the growth is especially vigorous; and then only on stiff clay lands with insufficient vegetable matter to keep open the channels for the flow of an increased supply of lime solution, demanded by this increased growth.

Comparative Values of Normal Juice Factors.[1]

By RAYMOND ELLIOTT.

The methods used for determining the tons of cane in a factory where the cane is flumed directly to the crusher necessitates the use of a factor on the crusher or first mill juice Brix so that the various calculations can be made.

We know that as the cane comes to the mill to be ground, it is very difficult to sample because of the widely varying degrees of ripeness. Therefore, on rail and flume plantations, the control starts at the mixed juice scales.

It has been found that in flume cane factories the first expressed juice is diluted with water adhering to the cane, and in determining a factor to be used in calculating the weight of the cane, allowance has been made for this dilution, that is, the calculated cane weight refers to dry cane or rather to cane minus adhering water, but not that water which has been absorbed by the cane, this becoming a part of the juice in its transit from field to mill.

The cane weight on a flume plantation, where a constant factor is used will not vary as on a rail plantation where the cane is weighed. The rail weights will vary according to climatic conditions, trash content of cane and its ability of retaining water. In some cases where there is a flume near the mill, a train of cane may come directly to the scale and be weighed while there is considerable water still dripping from the cars. This extra weight goes in as cane and increases the tonnage of cane, making the ratio of cane to commercial sugar higher. On flume plantations these fluctuations do not occur, therefore, they have the advantage.

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[1] Paper presented at Third Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, 1924.

The object of the writer is to make a brief comparison of normal juice factors in order that we may see how important this phase of control is. The whole question may be summed up as follows: First, how important is the normal juice factor? Second, the weight of cane per ton of sugar being intimately connected with the normal juice, will the tons of cane per ton of sugar from a fluming plantation be strictly comparable with a factory weighing its cane? Third, is there any relation between the Java ratio and the normal juice factor?

I have taken an ordinary day's run at Paauhau Mill, T.H., and have calculated the tons of cane by using different factors. The table, which is to a large extent self-explanatory, is given herewith:—

AVAILABLE DATA.

Brix of crusher juice..	17·00
Polarization of crusher juice	14·80
Purity of last mill juice (discharge roller)	67·82
Purity of mixed juice	82·66
Fibre per cent. cane	12·81
Moisture per cent. bagasse	37·92
Polarization per cent. bagasse..	1·35
Tons polarization in mixed juice	76·91
Tons polarization in cane..	78·86
Polarization per cent. cane	11·60
Extraction of polarization per cent. polarization in cane.. ..	97·53
Tons of cane weighed	679·88
Normal juice factor calculated	95·06
Java ratio..	78·38

CALCULATIONS USING DIFFERENT NORMAL JUICE BRIX FACTORS.

FACTORS USED.	92	94	96	98	100	102	104
Normal juice Brix	15·64..	15·98..	16·32..	16·66..	17·00..	17·34..	17·68
Normal juice polarization	12·86..	13·14..	13·43..	13·70..	13·98..	14·26..	14·54
Normal juice purity..	82·20..	82·21..	82·22..	82·23..	82·24..	82·24..	82·25
Polarization per cent. cane ..	11·21..	11·46..	11·71..	11·95..	12·19..	12·43..	12·68
Extraction of polarization per cent. polarization in cane .	97·41..	97·47..	97·52..	97·57..	97·62..	97·67..	97·71
Tons of polarization in cane..	78·95..	78·91..	78·87..	78·83..	78·79..	78·74..	78·71
Tons of cane	704·28..	688·57..	673·53..	659·67..	646·35..	633·47..	620 74
Java ratio	75·74..	77·43..	79·12..	80·74..	82·36..	83·99..	85·68

Inspection of the figures show that the higher the normal juice factor, the higher the extraction and polarization per cent. cane, also the lower the tons of cane, and the lower also the tons of cane per ton of sugar. Furthermore, as the normal juice factor is increased, the Java ratio increases in proportion. Lowering of the normal juice factor reverses the above.

Assuming a 90 per cent. total recovery, we have for a 92 normal juice factor, 78·95 × 0·90 = 71·05 tons sugar, and the calculated tons of cane per ton of sugar is 9·91. Similarly for a factor of 104, we have 78·71 × 0·90 = 70·84, equalling 8·76 tons of cane per ton of sugar. The difference, or 9·91 less 8·76, is 1·15 tons of cane, or 0·09 ton cane per degree increase or decrease in normal juice factor.

If the fibre is decreased, other factors remaining constant, the extraction and polarization per cent. cane are increased with a correspondingly lower tonnage of cane, and also a lower tonnage of cane per ton of sugar. On increasing the fibre, the reverse is true.

The writer has calculated all of the normal juice factors for the different plantations from figures given in the Annual Synopsis of Mill Data for the years 1921, 1922 and 1923; and has plotted the factors and Java ratios. These agreed very closely when compared year by year. Each plantation, however, is not strictly comparable with another for the reason that some mills report only crusher juice while others report a mixture of crusher and first mill juice. The latter is generally called "first-mill juice." The crusher juice will roughly represent a juice extraction of 30 per cent., while the crusher and first-mill may go as high as 30 per cent.

At Paauhau, we have made a large number of determinations to ascertain the difference between the crusher and first mill Brix, an average of 97 tests giving the following:—Crusher juice Brix, 16·81; First-mill juice Brix, 16·48; a difference of 0·33.

On this basis, each tenth degree Brix would represent ± 0·59 in the normal juice factor, where the Brix is 17·00; and ± 0·50 where the Brix is 20·00. This difference does not seem large, but when calculating tons of cane using these differences, large discrepancies appear.

On a plantation where the cane is weighed, it has been my experience that the calculated factor varies from day to day. To-day it may be 94, to-morrow 98, and no visible reason for the change. But, over a long period, comparing crop to crop, the factor is quite constant. Following are some figures taken from the daily reports at Paauhau. They tend to show that rainfall influences the normal juice factor:—

Date—1924.		Rainfall, in inches	Normal Juice Factor.	Java ratio
March	24th	1·49	99·70	81·66
	25th	0·02	100·32	81 85
	26th	0·01	98·82	80·50
	27th	0·00	97 70	77·86
	28th	0·36	94·62	79·31
	29th	0·05	98·73	80·14
April	1st	0·00	95·06	78·38
	2nd	0 00	95·55	79·58
	3rd	0·00	95 76	77·17

When we have dry weather at Paauhau, generally the factor varies between 95 and 96, but as soon as it rains the factor rises. I think this may be due to the first expressed juice being diluted; hence a lower Brix and polarization, the purity remaining constant.

I would not say that rainfall had everything to do with the variation of the factor. There are other conditions which to a greater or lesser extent influence the above, for instance, whether the cane is plant or ratoon, if damaged by rats and borer, irrigated or non irrigated, its variety, etc.

The true average of 25 complete dry crushing tests at Paauhau gave a 95·17 normal juice factor based on the crusher juice; whilst the same calculated on the combined crusher and first-mill juices gave 96·67.

Summing up: In answer to the first question as to the importance of the normal juice factor, I would say that as far as the comparative value of the normal juice factor is concerned, it is quite useless to compare factory against factory under the existing conditions. If all factories were operating exactly alike, then the factor would be one of the most important figures that one could have in chemical control. To the second question: As long as flume cane factories calculate their cane weights and all use different normal juice factors, their tonnage of cane per ton of sugar will not be comparable with those factories weighing their cane. Lastly, the Java ratio is important as there is a direct relationship between the two figures.

More time, attention and thought should be given to this important subject and its value be frequently determined by all plantations on a uniform basis.

Hydrogen-ion Values Compared with Titration Figures for Beet Sugar Factory Juices.[1]

By H. S. PAINE, B. C. SIBLEY and J. C. KEANE.
Carbohydrate Laboratory, U.S. Bureau of Chemistry.

OBJECTS OF THE INVESTIGATION.

The hydrogen-ion concentration (*pH*) is to be regarded as a more direct index of proper flocculation conditions in beet diffusion juice than are titration values. Even if *pH* and alkalinity titration values should vary in a closely identical manner, the control of carbonatation and of sulphuring by determining the *pH* might be more simple and less time-consuming than the titration of alkalinity, provided convenient and sufficiently accurate colorimetric methods were available or provided a suitable automatic recording system for electrometric determination of *pH* values were devised.

METHODS AND APPARATUS.

An attempt was made first to employ a colorimetric method, but after trial of a number of indicators, no combination was found to be entirely satisfactory for the range of *pH* to be investigated. More extended trial may, however, result in the selection of indicators better suited to the purpose. We found it desirable in the survey of *pH* values here described to employ the electrometric method,[2] using an Elliott-Acree[3] double hydrogen electrode vessel, platinum electrodes coated with palladium black, and a potentiometer of portable type. This apparatus was found to give satisfactory results.

Before making measurements in the factory, data on beet liquors obtained by this apparatus were checked with satisfactory results by using a Clark[4] apparatus with calomel and hydrogen electrodes. The apparatus was also checked periodically during the course of the field work against standard buffer solutions varying by 0·2 *pH* over the range to be investigated.

EXPERIMENTAL PROCEDURE.

The measurements of *pH* were made during the 1923 campaign at two beet sugar factories, one in Idaho and the other in Nebraska. Systematic examination was made only in the case of diffusion juice, first and second carbonatation juices, and third saturation juice, using catch samples and three-hour composites. Titration and *pH* values were determined simultaneously on all, the object being primarily to make a comparison of these two series of values for each liquor. Alkalinity and acidity were determined by titrating 10 c.c. of liquor with N/28 sulphuric acid or sodium hydroxide, using phenolphthalein as indicator, the results being expressed in grms. of calcium oxide per 100 c.c. of juice.

In titrating with acid the usually accepted colour change of phenolphthalein occurs at 8·2-8·5 *pH*; hence it will be noted that with phenolphthalein used as indicator in the titrations, the *pH* of the liquor before titration and the *pH* at the end of titration (which corresponds to the point of colour change of phenolphthalein), represent the initial and the final *pH* values of a *pH* titration curve the intermediate data of which are lacking. Consequently, to the extent that the *pH* and the alkalinity titration values vary in a relatively constant manner, it can be said that the amount of acid required to pass from the higher to the lower *pH* value upon titration is a constant function of the change in *pH*.

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[1] Abridged from a paper presented before the Division of Sugar Chemistry at the 67th meeting of the American Chemical Society, Washington, D.C.; already abstracted, *I.S.J.*, 1924, 313.

[2] Subsequent to the completion of our measurements, Aten and van Ginneken published some electrometric *pH* data pertaining to beet liquors. (*Tijdschrift*, 1924-5, 89).

[3] "Hydrogen-ion Determinations," Pyroelectric Bi-monthly Bulletin, 14th September, 1920, 3-8; E. A. Slagle and S. F. Acree, *Abstracts of Bacteriology*, 1921, 5, 5.

[4] Clark, in his book: "The Determination of Hydrogen-Ions."

DISCUSSION OF DATA.

The *pH* of diffusion juice in the Idaho factory varied from 5·4 to 7·6, with an average of 6·5, and in the Nebraska factory from 5·8 to 7·9, with an average of 6·5. Soda ash was added in both factories, and the acid-base equilibria in these cases are, therefore, modified by its presence, but this fact does not interfere with a study of the *pH* and titration values for the purpose of determining their simultaneous relationship. The average *pH* values for first carbonatation juice, second carbonatation juice and third saturation juice were, respectively, 11·2, 9·9, and 9·2 in the Idaho factory and 10·8, 9·1, and 8 4 in the Nebraska factory.

If these data be plotted on co-ordinate paper with time in days as abscissae, and *pH* and titrated alkalinity (as grms. of CaO per 100 c.c.) as ordinates on a double scale, curves showing comparatively the chronological variation in *pH* and alkalinity are obtained.[1] It will be noted that while the general contours of the alkalinity and *pH* curves are similar, there are a number of points on the curves at which titrated alkalinity and *pH* do not vary in a relatively identical manner. It is therefore concluded that there is no constant similarity in the variations of the titrated alkalinity and *pH* values of beet liquors, and that in cases where the closest control is desired an investigation of the *pH* values should receive consideration.

If, further, the average of all the *pH* values determined for a given liquor in each factory be expressed graphically as an ordinate and the averages of all titration values (calculated as grms. of CaO per 100 c.c.) for the same products as abscissae, there is obtained a smooth curve which, from the region of *pH* 11·4 shows a gradual decrease of *pH* with decreasing alkalinity until the region of *pH* 9·0 to 10·0 is reached, after which there is a more rapid decrease of *pH* with decrease of alkalinity, until a *pH* as low as 6·4 is reached.

In the Idaho factory the average *pH* values for first and second carbonatation and third saturation juices were systematically higher for a given average titration value during the second half than during the first half of the campaign. The average *pH* values of these three juices, corresponding to definite titrated alkalinities in the Nebraska factory, were considerably lower than those for either the first or second half of the Idaho campaign. In other words, the acid-base equilibria were such as to give higher *pH* values in the Idaho factory for given titration values than in the Nebraska factory. This would indicate, for a given amount of total base or acid, the predominance of stronger bases or weaker acids in the Idaho factory. Variation of soda ash in addition would be expected to exert an influence, though stored beets were used exclusively during the final two weeks of the campaign at the Nebraska factory and in predominant proportion during the second half of the campaign at the Idaho factory.

VARIATIONS NOT CONSTANT.

Inspection of the curves indicated that there is no constant similarity in variation between *pH* and titrated alkalinity values for any given liquor in the same factory; in other words the *pH* value is not a constant function of the titration value. Comparison of the slopes of the curves also shows a different function or relation between *pH* and titrated alkalinity under the conditions represented by the three curves. The maximum variation between *pH* and titration values for all the data presented is probably to be found by comparing the *pH* values corresponding to any definite titration value in the Nebraska campaign and second half of Idaho campaign curves. In other words, there is a greater variation when comparing one factory (or region) with another than when making a chronological comparison of *pH* and titrated alkalinity for one liquor for a comparatively limited period in the same factory. This is a conclusion which might be anticipated, and it is also probable that a considerable variation between *pH* and titration values will be found when comparing different campaigns in the same factory, particularly when weather conditions vary considerably or when there is a variation in the types of soil in which the beets are grown.

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[1] These curves are reproduced in the original paper.

During two periods of two or three days each in the Idaho factory, fairly badly deteriorated beets were used in predominant amount. In both instances, there is a striking coincidence of pronounced dips toward lower *pH* values in the four curves representing diffusion, first and second carbonatation, and third saturation juices, about three days being represented between the beginning and end of the dips. During the second period, especially, there was practically no similarity between the variations in *pH* and titrated alkalinity. Here, again, the *pH* value is a more direct index than the titration value for changes in acid-base equilibrium.

It must be remembered that some of the variations may be due to difficulty of close control of the station rather than to a variation in the *pH* representative of the operation in question. For instance, if it were possible to stop the process of first carbonatation sharply at the so-called "break," or point of maximum flocculation or sedimentation, the chronological *pH* curve for first carbonatation juice would be strictly representative of the variation in *pH* at which the "break" occurs for different lots of diffusion juice. Such an exact relation could possibly best be obtained by relatively small scale experiments in which particular care is exercised to see that carbonatation is carried exactly to the "break" in each instance. However, the average *pH* values for first carbonatation juice in the Idaho and Nebraska factories should be fairly typical. These were 11·2 and 10·8 respectively.

In view of the fact that filtrability, as well as elimination of non-sugars, is a determining consideration in factory operation, carbonatation of diffusion juice to the "break" is, after all, not only a practical but also a scientific criterion of carbonatation. This is quite in agreement with conclusions which have been reached from determination of *pH* values in connection with the lime defecation of cane juice in raw sugar manufacture. It is desirable, however, to know more definitely the possible extent of variation of the *pH* of first carbonatation juice when the juice is in all cases carbonated precisely to the optimum point for maximum clarification and minimum sugar loss. The constructive value of *pH* control for increasing average non-sugar elimination, particularly during second carbonatation and third saturation should also be investigated. It may also be added that *pH* data in conjunction with ash analyses and alkalinity values of ash can be utilized to advantage for studying acid-base equilibria and for investigating a number of sugar factory problems involving primarily the behaviour of salts.

PROPOSED USE OF TEST PAPERS.

Recently the use of thymolphthalein and thymol blue test papers for control of first and second carbonatation, respectively, has been proposed by SCHONEBAUM.[1] It is stated by TÖDT[2] that a light blue colour of thymolphthalein test paper usually indicates the correct termination of the first carbonatation and that of second carbonatation by a bright blue colour of thymol blue test paper. It is evident, however, that only a limited *pH* range can be covered by these test papers and it remains to be determined whether this range is sufficiently great to meet the requirements of factories operating under the different conditions which exist. For instance, in this country the titrated alkalinity of first carbonatation juice is generally lower in a Steffen than in a non-Steffen factory.

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[1] *Tijdschrift*, 1924-5, Nos. 2, 3, 4.

[2] *Vereinszeitschrift*, 1925, 65; *I.S.J.*, 1925, 275.

The *pH* ranges of thymol blue (thymol sulfon phthalein) and thymolphthalein are given by CLARK[1] as yellow 8·0-9·6 blue and colourless 9·3-10·5 blue, whereas our data show average *pH* values of 11·2 (Idaho) and 10·8 (Nebraska) for first carbonatation juice and 9·9 (Idaho) and 9·1 (Nebraska) for second carbonatation juice. The bright blue colour of thymol blue test paper coincides exactly with the average *pH* value 9·1 found for second carbonatation juice in the Nebraska factory. However, in the Idaho factory the average *pH* values 9·9 and 11·2 for second and first carbonatation juices, respectively, would correspond to such deep blue tints of the thymol blue and thymolphthalein test papers as to pass beyond the range of these indicators.

Deterioration of Cane Mill Juices from the Aspect of Acidity Increase.[2]

By W. L. McCLEERY

For a number of years it has been increasingly evident that during milling operations there is a considerable loss of sucrose from deterioration due to bacterial action. The absence of a direct method of accurately determining sucrose in cane entering the factory has tended to obscure such losses. They have been indicated from the comparison of purity differences between first expressed juice and mixed juice in factories operating under the usual conditions, and the lessened difference in these purities when steps were taken to keep the plants in as sanitary a condition as possible. The development of bacteria around the mills results in acid products, and the increase in acidity may be used as an index of the amount of bacterial development. In 1923, Mr. ROBERTS found that the acidity of mill juices in the latter part of the train was as high or even higher than in the crusher juice, an unexpected condition, as, due to the effect of compound maceration, it would be expected that the acidity would decrease in proportion to the density. Steps were taken to keep down all sour accumulations, etc., as explained later and the results were immediate, the results being expressed as acidity per cent. Brix. This year, after taking various steps to reduce bacterial action to a minimum, the actual percentage increase of acidity on this basis was found to be very small.

Following are extracts from Mr. ROBERTS' report on his work:—Cane stalks were examined and the juice as expressed by the laboratory mill was so much lower in acidity than that of the mixed juice, that it was evident that the acidity must be increasing in the milling plant. By analysing composite samples taken from each mill, from the pans below the mills, from pumps, macerators, juice troughs, tanks and supply pipes, and computing the results, it was evident that the increases in acidity and the subsequent losses due to this action were much larger than had been the prevailing opinion. The increase in acidity from first to last mill was especially marked towards the end of the week, making it practically certain that the deterioration was mainly due to an increasing unsanitary condition as the week advanced, the only thorough cleaning being given the mills on Sunday mornings.

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[1] See his book: "The Determination of Hydrogen-Ions"

[2] Paper presented at Third Annual Meeting of Association of Hawaiian Sugar Technologists, Honolulu, October 27th, 1924 (here abridged).

Another feature was the rather large difference of acidity between the intake and outflow of the maceration juices, indicating that deterioration was taking place, this being also true in the maceration distributors. (See Table II). But as soon as these spaces were frequently washed no appreciable increase of acidity was found. It was expected that the relation of acidity in first mill and mixed juice would be in direct proportion to the dilution applied, but the acidity per 100 c.c. was in many cases as high or even higher in the third and fourth mill juices than in the crusher juice.

A system of cleaning and flushing with hot water and lime all spaces through which the juice passed, sometimes three and four times a day, was initiated, with the immediate result that the percentage of acidity decreased and the clarification improved.

With the beginning of the 1924 crop a routine was started by running hourly acidity tests on each mill juice and the mixed juice. Acidity figures were inserted in the daily mill reports, and each time the increase of acidity was higher than usual, the engineers would take measures to improve the existing conditions, the figure of acidity per cent. Brix being used.

The relatively small increase of acidity in Table II between Mondays and Saturdays, also between the crusher and last mill, when compared with the data in Table I for May, 1923, shows that it is possible for a factory to operate with a comparatively small percentage increase, thereby resulting in considerable saving of undetermined loss around the milling plant.

Table I.

AVERAGES FOR MAY, 1923.

	FIRST MILL.		SECOND MILL.		THIRD MILL.		FOURTH MILL.	
	Brix.	Acidity.	Brix.	Acidity.	Brix	Acidity.	Brix.	Acidity
Mondays	19·70	0·086	9·10	0·154	6·24	0·160	2·88	0·209
Tuesdays	20·31	0·089	9·66	0·155	6·00	0·217	2·77	0·361
Wednesdays	20·24	0·079	9·50	0·179	5·80	0·276	2·52	0·595
Thursdays	19·60	0·077	8·70	0·161	5·40	0·278	2·20	0·727
Fridays	21·00	0·076	8·55	0·187	5·20	0·308	2·05	0·732
Saturdays	20·40	0·079	8·90	0·225	5·10	0·392	2·05	1·024
Average	20·21	0·084	9·07	0·177	5·62	0·267	2·61	0·529

Table II.

AVERAGE CROP, 1924.

	Average Crop, 1924.			All Mondays' Crop, 1924.			All Saturdays' Crop, 1924.		
Crusher	19·99	0·0096	0·048	20·61	0·0085	0·041	19·70	0·0114	0·058
First mill	18·10	0·0092	0·051	18·57	0·0076	0·041	18·02	0·0112	0·062
Second mill	8·60	0·0051	0·059	9·00	0·0039	0·043	8·34	0·0061	0·073
Third mill	5·84	0·0036	0·061	6·10	0·0028	0·046	5·21	0·0040	0·076
Fourth mill	2·13	0·0014	0·068	2·47	0·0012	0·049	2·97	0·0024	0·082

As a result of the above work done by Mr. ROBERTS, the writer has made similar acidity tests on his visits to 12 other factories operating under usual conditions, the increase of acidity being found very marked, especially in factories with the longer trains (see Table III).[1]

The type of mill juice strainer in general use is not self-cleaning and sour accumulations gather under the screens. This probably accounts for the largest part of the acidity increase found in the different factories, the balance coming from sour accumulations around the mill beds, cheeks, juice flumes and receiving tanks.

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[1] Here condensed.

Table III.

Acidity Increase between Units expressed as Percentage.

Percentage Increase between Units.	1st to 3rd.	1st to 4th.	1st to 5th.	1st to 6th.	1st to 7th
Olowalu Company[1]	—	24	—	—	—
Olowalu Company	106	140	—	—	—
Kohala Sugar Company	35	122	—	—	—
Hawi Mill & Plantation Co., Ltd.	34	75	88	—	—
Lihue Plantation Co., Ltd.	67	256	300	—	—
Oahu Sugar Co., Ltd., "A"[2]	77	160	195	—	—
Waialua Agricultural Co., Ltd.	56	109	145	—	—
Pioneer Mill Co., Ltd.	117	141	237	260	—
Pioneer Mill Co, Ltd.	73	105	160	190	—
Ewa Plantation Company	158	285	430	454	525

With intensive milling it is probable that acidity increase cannot be entirely eliminated, but the evidence above indicates that when precautions are taken to keep the plants in a sanitary condition the increase can be kept down to a small amount.

Antiseptics are hardly to be recommended, as in the writer's opinion large quantities would have to be used to become effective. The use of a high pressure hot water hose with a small outlet is the best means of dislodging all accumulations, the flushing being done every three hours. If done often, only small amounts of water will be needed and a minimum of juice dilution will result. A steam hose, while effective at points close to the nozzle, would not have enough force to dislodge accumulations under the screen in the juice strainer.

The acidity test is simple and can be readily made in any laboratory with N/2·8 sodium hydroxide and sensitive neutral litmus paper, as follows : 100 c.c. of the juice are transferred to a porcelain dish, and the standard alkali run in from a burette, a few tenths of a c.c. at a time. After each addition of alkali, stir and test with special neutral litmus paper by making a mark across the width of the paper with the stirring rod. The first trace of blue colour denotes the end point. Each cubic centimetre of alkali of the above strength represents 0·01 per cent. acidity in terms of minus CaO. Therefore, a crusher juice titrated as above taking 2·1 c.c. of alkali will have an acidity of 0·021 per cent. With a crusher juice Brix of 22·1 the acidity per 100 Brix or acidity per cent. density would be 0·095, this being obtained by dividing the per cent. acidity by the Brix and multiplying by 100. See "Methods of Chemical Control," 1924, page 42, "Titration with Litmus."

The saving effected by stopping deterioration around the milling plants is hard to express in definite terms, as the decomposition processes are very complex. If it is assumed that the acidity increase is acetic acid at the direct expense of sucrose, the difference between the 1923 and 1924 conditions might amount to a saving in sucrose of about 1·75 per cent., but because of lack of sufficient reaction data, this figure may not be very close. From the juice purity aspect more definite figures can be given : a depression in mixed juice purity of 1·0 through deterioration, which is not unreasonable according to other tests, corresponds to about 1·2 per cent. sucrose loss. This in turn amounts to approximately an additional 1·0 per cent. lower recovery in the boiling house, or a total of 2·2 per cent. It is therefore evident that any saving of undetermined loss around the milling plants by preventing deterioration is well worth the effort expended.

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[1] Tests taken about 20 mins. after starting from a clean mill.

[2] Test on "A" tandem with unstrained juice pump.

The Isoelectric Theory: its Application to the Defecation of Cane Juice.[1]

By F. HARDY, M.A.,
Professor of Chemistry and Soil Science, Imperial College of Tropical Agriculture, Trinidad.

THE ISOELECTRIC THEORY.

The isoelectric point of proteins.—The conception of the isoelectric point is due to W. B. HARDY,[2] of the University of Cambridge, who observed the remarkable behaviour of boiled egg-white protein suspended in water through which an electric current was passed. He found that the direction of movement of the egg-white particles under the influence of the electric current could be controlled merely by adding alkali or acid to the liquid. When the reaction of the liquid was alkaline, the protein particles migrated to the positive electrode, and therefore must have carried electro-negative charges; when the reaction of the liquid was acid, they moved towards the negative pole, indicating that their charges then had positive sign. Very small degrees of alkalinity or of acidity were found to be sufficient to produce these results. When the reaction of the liquid approximated to neutrality, the protein particles remained stationary. At this point, the particles therefore could have possessed no resultant charge, neither negative or positive, so that their condition was *isoelectric*. These observations with egg-white have since been reproduced for many other proteins.

The electrical behaviour of proteins, however, is not in itself of such great interest as the changes in properties that occur when proteins are brought into the isoelectric condition. Many of the properties of proteins dispersed in water, depend on the *degree of hydration* of the particles, that is, on the intimacy of their relationship or association with water molecules.. It has been amply demonstrated that the degree of hydration of certain proteins tends towards a minimum as the isoelectric point is approached, whether from the alkaline or from the acid side. Thus, at the isoelectric point, suspensions of these proteins exhibit least viscosity, and possess least stability. Frequently, they are spontaneously precipitated when brought into the isoelectric condition, or they may easily be precipitated at this point by heating, or by adding alcohol, which aids in effecting further dehydration.

The whole subject of hydration of matter, whether it be colloidal, molecular or ionic matter, is not only intimately bound up with colloidal behaviour, but also with the question of solubility of matter in water. In general, soluble matter may perhaps be regarded as matter which enters into intimate relationship with water molecules; and insoluble matter, that which exhibits no such propensity. According to this simple view, the effective precipitation of hydrophilous colloids by added simple ions is therefore decided by the ability of the simple ion either to cut off the colloid from close association with water in the case of *lightly* hydrated colloids, or to reduce the degree of hydration in the case of *heavily* hydrated colloids, by abstracting water from them. In the first case, the precipitation process is essentially similar to that which occurs in many simple electrolytic interactions, whereas in the second case, the process is quite different, being the result of actual water abstraction. Between these two extremes, intermediate cases doubtless exist. A recognition of these facts will enable one to correlate certain phenomena that at first sight appear incompatible, as a study of the specific examples to be described should clearly show.

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[1] Abridged from *Tropical Agriculture*, 1925, 2, 179-181, 231-233. In a prefatory note to this series of articles by Prof. HARDY, it is pointed out that the Isoelectric Theory of Colloidal Behaviour is nowadays receiving close attention from scientific workers in many fields, and already its application has helped to solve numerous problems that have heretofore baffled investigators, in that it has replaced empiricism by scientific orderliness. It must be admitted, however, that the Theory presents some serious difficulties and limitations, and that it is by no means a final statement of truth. Nevertheless, owing to the suggestive nature of certain of its bearings, it is of some interest to publish this account of the Theory as applied to the defecation of cane juice.

[2] *Proceedings of the Royal Society*, 1900, 66, 110.

THE DEFECATION OF CANE JUICE.

The principal colloidal substances that occur in fresh cane juice are proteins, pentosans, pectins, colouring matters, hydrous silica, waxes, fats and soaps. In addition to these, varying amounts of different colloidal decomposition products of celluloses, such as pentosans and pectins, are generated during shredding, milling and maceration, and even during defecation itself, through the hydrolysis and breakdown of the components of minute particles of fibre or *bagacillo* that pass the juice strainer.

The colloids of cane juice exhibit various degrees of hydrophily ; thus, the protein, pentosan and pectin components appear to be very *highly* hydrated, whilst colouring matters, silica and fatty substances are probably only relatively *slightly* hydrated. We should therefore expect in accordance with our preliminary considerations, marked differences in behaviour in the two types of colloids during factory treatment.

TYPE A :—HIGHLY HYDRATED COLLOIDS.

(1) *Proteins.*—The soluble protein component of cane juice (comprising some 9 per cent. of the total non-sugar solids), is probably mainly albumin, along with its products of hydrolysis or of intermediate metabolism, namely, proteoses (albumoses), peptones, polypeptides and amino-acids. Albumin is altered or "denatured" in some way by heating. The denatured product, unlike the natural substance, appears to be relatively lightly hydrated; it, therefore, exhibits marked amphoteric properties, as was shown by W. B. HARDY in his experiments on boiled egg-white, previously mentioned. Hence, one important effect of heating cane juice is to render its albumin component more susceptible of precipitation, either spontaneously (particularly at the isoelectric point), or through combination with certain added simple ions such as calcium-ion. The importance of the first effect has been sufficiently stressed by FARNELL.[1]

Proteoses, and other simple associations of amino-acids, are not strictly colloidal. They are probably little affected (dehydrated) by heating. Nevertheless, they play an important rôle, along with the higher proteins, in that their amphoteric properties "buffer" cane juice against changes in acidity or alkalinity, and thus protect it from the deleterious effects of excessive liming.

(2) *Pentosans.*—Unlike albumin, pentosans ("cane gum"), in aqueous dispersion, are apparently not denatured (dehydrated) by heating. Their stability in the highly hydrated condition, therefore renders them particularly capable of resisting precipitation during the ordinary processes of defecation, so that pentosans form a conspicuous component of final syrups and molasses. The relatively low concentration at which simple ions occur in cane juice which has been treated with the various electrolytes (such as lime), that are employed in the cane sugar factory, is probably ineffectual in producing the so-called lyotropic precipitation effects discussed in a previous section.

In practice, partial elimination of pentosans from cane juice may apparently be brought about either by generating some highly re-active flocculent solid within the juice (as in the carbonatation process, and use of lime and phosphoric acid), or by adding to the juice a suitable substance previously prepared for the purpose (as kieselguhr, hydrous aluminium silicate). It is believed that, in both cases, the solid "adsorbs" some of the pentosan, and, by entrainment, removes it from the juice on subsequent settling or filtration.

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[1] *I.S.J.*, 1924, 26, 233.

There is some doubt as to the relative efficiency of these agents as pentosan removers, and further specific investigations are urgently needed to test their value. Some authorities maintain that effective adsorption by solid particles of even such highly hydrophilous colloids, as pentosans, is partly controlled by reaction, being especially favoured by acidity. The writer recently examined the effect of simple ions on solutions of pure araban at different *pH* values, and noted that certain ions which tend to produce cloudy precipitates were especially effective in the more highly acidic solutions (*pH* 2·5 to 3·9). This result probably depends, however, on a suitably high concentration of pentosan, but at least it indicates a *tendency*. Nevertheless, one should regard adsorption at a surface primarily as a function of the reactivity of that surface, although doubtless both this factor, as well as the tendency of a colloidal solution to separate into its phases, is conditioned largely by external circumstances, in particular, by hydrogen-ion concentration.

Apparently insufficient attention has been given by sugar technologists to the fundamental question of adsorption at surfaces in relation to the efficacy of clarification processes in cane sugar manufacture. Indeed it appears from the very recent work of Bond in Hawaii[1] that defecation by liming is primarily a function of the phosphate content of sugar cane juice, for, the higher the phosphate content, the greater the quantity of flocculent hydrous calcium phosphate produced, and the better the defecation. Herein may lie a definite relationship between soil conditions, manurial treatment and sugar factory experience, for agriculture can no longer be regarded as entirely divorced from the manufacture of tropical crop products.

(3) *Pectins.*—Because of their high degree of hydration, pectins somewhat resemble pentosans in their behaviour during sugar manufacture, but, because of their different chemical constitution, they exhibit certain peculiar features which are worthy of special mention. The unsatisfactory state of our knowledge concerning the constitution and mode of occurrence in plants of pectic substances, has been considerably corrected by recent researches, e.g., by Nanji, Paton and Ling,[2] but much still remains to be done from the point of view of colloid science.

Pectin occurs in plants probably as an insoluble "salt" (protopectin) containing calcium, magnesium and perhaps iron.[3] During ripening processes, protopectin may become "soluble" (yielding pectinogen), and finally, through hydrolysis, de-esterification may occur, resulting in the formation of a new substance (pectic acid). Chemists have explained these changes mainly without reference to colloidal behaviour. It is perhaps justifiable to assume, however, that the so-called protopectin salt is actually a colloidal complex rendered insoluble by surface combination with precipitating ions (Ca, Mg, Fe,), acting in a medium of reaction alkaline by reference to an isoelectric point. When the medium is rendered more acid, the metallic ions may be progressively replaced by hydrogen-ions, so that the colloid finally becomes "soluble," or the anions of the added acid may remove the adsorbed metal ions by forming insoluble simple salts therewith (for example, oxalic acid gives insoluble oxalates). Once in solution, pectinogen might behave in a reverse direction under the influence of altered reaction and of added metallic ions. Thus, in the defecation process, the pectinogen present in cane juice may be partly eliminated by the combined effect of heat and lime—the one causing dehydration, and the other precipitation, through increased hydroxyl-ion and calcium-ion concentration. It is quite likely that pectinogen is much more prone to dehydration on heating than are pentosans. FARNELL,[1] however, interprets pectin precipitation differently. He assumes that liming actually hydrolyses (de-esterifies) the pectinogen of cane juice, producing pectic acid, and that this then forms insoluble "calcium pectate." In any event, pectic substances appear to be effectively eliminated in the ordinary defecation process, in which respect they differ from pentosans. The total pectinogen content of sugar cane juice rarely exceeds 1½ per cent. of the total non-sugar solids (compare 9½ per cent. for pentosans), so that usually little trouble is experienced in removing them completely.

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[1] *I.S.J.*, 1925, 311. [2] *I.S.J.*, 1924, 390. [3] *Loc. cit.*

TYPE B:—SLIGHTLY HYDRATED COLLOIDS.

(1) *Colouring matters.*—Not much appears to be known about the physico-chemical properties of plant pigments; most of the work so far accomplished has been concerned mainly with the elucidation of their chemical composition and structure. The soluble plant pigments occurring in cane juice comprise a catechol tannin and, in some cases, certain red and purple authocyanin-like compounds. These substances are little removed during ordinary defecation processes, but require powerful adsorbents, such as decolorizing carbons, for their complete elimination. They can scarcely be regarded as typical hydrophilic colloids, and are perhaps best classified as semi-colloidal compounds possessing the properties of indicators.

During defecation, various other colouring matters are produced in sugar factory liquors, especially when cane juice is limed to relatively high alkalinity. Most of these secondary pigments appear to be cyclic compounds of "humin" type, and may be derived, either from the lignin component of cane-fibre, ligno-cellulose, or from reducing sugars. Little is known of their constitution and properties, beyond the fact that powerful adsorbents are required to remove them from solution.

(2) *Hydrous silica.*—Silica occurs in plants mainly as a hydrophilic colloid, either in the free state, or combined with other colloids. In addition, silica occurs in smaller amount in ester-like combination with some polysaccharide component of the plant, in much the same manner as sulphate and phosphate may occur.[2] In order to render the silica component of cane juice completely precipitable, it has been found necessary to superheat the juice to 116° C.[3] The precise effects of this operation are not clearly described in literature. They may be two-fold: (1) hydrous silica may be detached from colloidal combination through diminished hydration, and (2) the true organo-siliceous compounds may be hydrolysed (de-esterified) by the heat treatment. In any case, gelatinous hydrous silica is probably thus liberated in the free state into the juice.

There is evidence for the view that hydrous silica is a colloidal ampholyte, exhibiting an isoelectric point at approximately *pH* 1·2. Hence, free hydrous silica dispersed in previously superheated cane juice is exposed to an environment whose reaction is well on the alkaline side of its isoelectric point. The colloid will, therefore, behave as a highly active colloidal anion, and will readily combine with calcium-ions to form an insoluble calcium-silicate complex. In this way, liming and settling effectively remove all free hydrous silica from cane juice that has been suitably preheated.

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[1] *I.S.J.*, 1924, 26, 480.

[3] NANGI and SHAW, *J.S.C.I.*, 1925, 44, 1, 1T.

[2] MULLER, *I.S.J.*, 1921., 23, 579; also BIRD, *ibid.*, 1923, 25, 44, and FARNELL, *ibid*, 1923, 25, 358.

(3) *Waxes, fats and soaps.*—Waxes and fats occur in cane juice probably as anhydrous (suspensoid, hydrophobic) colloids, or at least as only slightly hydrated colloids. In themselves, they are not amphoteric compounds; indeed they are scarcely soluble in water. Nevertheless, because of their fine state of subdivision, they exert a marked effect in retarding filtration of sugar liquors. They are also troublesome in that they produce evaporator scale. When acted upon by alkalies, fats and waxes, as is well known, they form soaps. Soaps may exhibit hydrophilous properties to a marked degree. Thus ordinary sodium soap behaves as a hydrous colloidal electrolyte, yielding sodium-ions and colloidal fatty-acid anions on dissociation. The sodium-ions of soaps may therefore be combined chiefly at the surface of colloidal anions, and may be susceptible of replacement by, say, calcium-ions, yielding insoluble complexes (calcium soaps).

In sugar manufacture, hydrolysis of waxes and fats doubtless occurs as a result of heating at certain (relatively alkaline) reactions, but the use of lime effectively prevents any manifestation of hydrophilic behaviour, because insoluble calcium complexes are immediately produced. Nevertheless, even floccules of calcium soap appear still to hinder filtration, because of their greasy nature, so that the addition of some mechanical aid, such as kieselguhr is often found necessary in order to effect easy elimination of fats and waxes from sugar liquors.

It is evident from the foregoing discussion, that the application of the isoelectric theory of colloids to the complex system, cane juice, brings out many obscure interrelationships, whose recognition helps the student not only to visualize various changes that occur during defecation, but also to suggest fresh research along lines that might lead to improvement in existing methods.

Department of Overseas Trade Reports.

SPAIN.

The crop yield from cane sugar for 1924-25 is below that of the last few years This s said to be due not only to the ravages of the disease referred to in last year's report, but also to the fact that the climate in the sugar cane districts appears to be gradually changing. The usual varieties of cane do not seem able to withstand the lower temperatures.

The production of beet sugar has reached the record figure of 213,000 tons, as against 164,000 tons in 1923. The average price of beet in the Granada district was about pesetas 100 per metric ton, and the average yield of sugar per ton, 12 per cent.

It is estimated that from every metric ton of beetroot, molasses valued at 8 pesetas, and pulp valued at 4 pesetas, are obtained, in addition to the sugar.

THE JUGO-SLAVIA BEET SUGAR INDUSTRY.

Owing to the high prices promised to the peasant producers and the exceptionally favourable weather conditions, an abnormally heavy crop of beet sugar was produced in 1924, the total quantity of roots grown being estimated at 1,200,000 metric tons, and the sugar manufacturers, who have in previous years complained of the shortage of raw material, were faced with another situation—that of being under contract to pay for beet at higher prices than the state of the world's sugar market warranted. In some cases the money with which to pay the growers for the beet delivered was not forthcoming within reasonable time, and this circumstance, together with the difference between the price offered in advance for the 1925 crop and that demanded by the growers, has led to a struggle between the peasants, who formed an association of sugar beet growers, and the cartel of manufacturers. At the time of writing this struggle is still acute.

It is said that when fixing in advance the prices for the 1924 beet crop the manufacturers based their calculation on the price of £30 per ton for sugar, whereas at the time they had to buy in the roots, the world's market price had fallen to £16 or £17 per ton.

Department of Overseas Trade Reports.

It is estimated that the total production of sugar for 1924-25 will reach 136,000 tons. Jugoslavia's consumption of sugar is from 70,000 to 80,000 tons per annum, so that there should be an exportable surplus of from 50,000 to 60,000 tons, mostly of the qualities known as granulated and fine granulated. Locally grown sugar enjoys the protection of a duty of 3·30 dinars[1] per kilogram, and it has been recently decided to reduce by 30 per cent. the freight charges on sugar carried by the State railways. Strenuous efforts are being made to find markets abroad for the surplus sugar, and some has already been exported to Italy and Rumania.

Correspondence.

THE ORIGIN OF MOSAIC IN CUBA.

To the Editor, "The International Sugar Journal."

Sir:—With regard to my claim made in your January issue that Argentina can be absolved from any charge of having been responsible for the introduction of mosaic into the various sugar producing countries of the American continent, I beg to offer some additional evidence that this country is not to blame so far as Cuba is concerned.

It appears that the Havana newspaper *El Sol* in its edition of the 15th of June, 1924, published an account of a lecture given by Ingeniero Gonzalo M. Fortun, Director of the Estación Agronómica of Santiago de las Vegas, Cuba, in which he was represented as having stated that the mosaic disease had been taken to that country for the first time in cuttings of cane imported from the Argentine. This account was reproduced and criticized by the Argentine sugar publication *La Industria Azucarera* in its number of August of the same year. This inspired Mr. Fortun to write to this journal in a letter published in December, stating that his lecture had been badly reported by the Havana newspaper, and sending them a copy of the lecture as read by him. The *Industria Azucarera* reproduced the lecture in full, but pointed out that Mr. Fortun had spoken at length about the P.O J. 36 cane they had imported from the Argentine, and the fact that it was infested with the mosaic disease, without stating very clearly that this was not the variety which introduced the mosaic disease into Cuba for the first time.

In answer to this last criticism, Mr. Fortun addressed another communication to the *Industria Azucarera*, which was published by that journal in April last. In this letter he says: "I have just read through the December number of your interesting journal, and have pleasure in writing to you again in order to confirm my explanation of the point referred to in my last letter which you publish. Without wishing to initiate any controversy on the matter I wish to point out the fact that what I said in my lecture was that the Java 36 cane which came from the Argentine Republic was that from which we got acquainted with the mosaic disease in the Estación Experimental Agronómica, but at the same time I did not fail to state clearly a number of times, and in great detail, the fact that at that time the disease was already known in the district of Cienfuegos, where it existed in the plantation of the Central Soledad, and also in the eastern part of the island, in the neighbourhood of the Termino Municipal de Guantánamo. I stated also that the origin of the infestation of these two districts was not known. It can be stated that we know very definitely therefore, without the slightest doubt, that the mosaic disease was known in Cuba before the Java 36 cane was introduced here, and this statement I affirmed without any ambiguity whatsoever in my lecture to which you refer. I hope therefore that you will interpret my conference in this way. The introduction of the mosaic disease into Cuba is not to be attributed to the Java 36, as we know that the disease was prevalent in Cuba before the introduction of this cane, even the exact districts being known. It was the appearence of the disease in the Estación Experimental Agronómica for which the Java 36 was responsible."

Estación Experimental Agrícola,
Tucuman,
Argentina.

Yours very truly,
Wm. E. Cross.

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[1] 1 Dinar is normally equal to 1 franc.

Publications Received.

The Elements of Sugar Refining. O. F. Bardorf and J. A. B. Ball. x + 240 pages; 8vo. (The Chemical Publishing Company, of Easton, Pa., U.S.A.; Williams & Norgate, London, England.) 1925. Price: 20s. net.

As the Canadian authors of this new work remark, books on the subject of sugar refining are remarkably few in number, an unfortunate fact in every way. Their contribution, though not a lengthy one, contains a good amount of useful matter, of value more especially to the young technologist; and it therefore forms an opportune addition to the literature.

Dividing their work into three parts, they deal in the first with raw sugars, their chemical and physical characteristics. These four chapters are of value alike to the technologist and the commercial man, especially that on valuation for refining purposes. But the general acceptance in the calculations of "polarization" as representing the sucrose in blackstrap will surely lead to erroneous results, assuming that here the direct polarization is indicated. Three graphs on pages 22-23 are really quite illegible, and their position in the book is not as stated later on page 41. Then, having observed that the rate of inversion of solutions of centrifugal and molasses sugars is more rapid in the instance of the latter lower-grade product (other conditions being equal), this phenomenon is assumed to be due to "some form of catalytic action on the part of the reducing sugar, which in such cases may play the rôle of an invertive agent," a theory which should be given some substantiation before publication in an elementary textbook. Part II deals with refining operations proper, affining, clarification, char filtration, boiling various grades and working up intermediate and end products. This is the most important section of the book, and summarizes in an adequate way the practice of the art. Here again one must remark on the editing of the book, e.g., that the system of contractions adopted is not an attractive one, so that the effort to follow a "typical system of filtration" on pages 72-73 is not lessened in consequence; while references are made on pages 74-75 to "Table VIII," which does not appear to find a place in this edition. Part III is mostly taken up with a consideration of the materials used in refining, particularly with char, its manufacture being described; and the chapter on technical and commercial balances is by no means the least useful part of this section. It may be added that Messrs. Bardorf and Ball throughout their book treat of the elements of refining mainly from the chemist's point of view, excluding in consequence detailed descriptions of plant and omitting engineering questions in general.

Summing up briefly the value of this new work on refining, it may be stated that it contains much useful practical information on the art which hitherto has not appeared in print, and that, seeing this information is for the greater part accurately and clearly expressed, it is therefore a volume which should be appreciated in our industry. But one is obliged at the same time to remark that the book is somewhat marred (especially as it is a work intended for the student) by the typographical errors it contains. These are too numerous, and a little more care in passing the volume for the press would have resulted in a more satisfactory contribution.

The Configuration of the Saccharides. By Prof. Dr. J. Böeseken, of the Technical University of Delft; translated by Dr. Samuel Coffey. Part I: Monosaccharides; Part II: Polysaccharides. (A. W. Sijthoff's Publishing Co., Leyden, Holland). 1925. Price: Fl. 6·0 (for both parts).

This monograph (which is the second of a series of *Monographies chimiques, théoretiques et pratiques*, published in French and in English by the Chemical Society of Holland), gives an account of the investigations which have led to our present knowledge regarding the chemical configuration of the various members of the sugar group. Only the most essential points regarding the empirical composition of these substances are therefore here considered; but the position of their atoms in space is treated in a fair amount of detail, considering the scope of the publication. Chapter I of the First Part deals with the composition of the aldoses and ketoses; Chapter II with the configuration of trioses, tetroses, pentoses, methyl pentoses and hexoses, and also at some length with the cyclic structure of the monosaccharides. Chapter I of the Second Part is a general discussion on the polysaccharides, this being followed by one on the composition of sugar-like bodies, and latterly of non-sugar-like forms, including of course starch and cellulose. This is a work which will be found to be of not a little value by the student of the chemistry of the sugars.

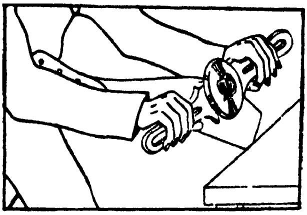
Rapid Means of Sharpening Cane Knives, Bills, Machetes, etc., using the "Acuto."

Generally for the sharpening of cane knives, cane bills, cutlasses, machetes, bolos, or other form of implement used for the harvesting of sugar cane, a grindstone is used for restoring its sharp edge, when after a time it has become blunted.

But this method has two disadvantages: In the first place, more time than is desirable may be expended on the operation, two men being required for it, one to turn the wheel, and the other to hold the knife to it.

In the second place, the use of a grindstone is wasteful of the life of the cane knife or other implement in use, since, even in fairly skilful hands, the blade is comparatively soon worn down.

A much more rapid and more economical means of sharpening is afforded by the use of the "Acuto" (shown in the illustration), the method of using which will at once be seen. It consists of a disc of hard steel, held by means of a screw in a frame, this device being used to finely pare the blade of the implement, leaving a very sharp cutting edge. In this way, much less of the steel is removed than in the case of the grindstone, and sharpening is effected in a fraction of the time.



With the handle of the knife against the chest, and the other end resting against a block of wood (which may be fixed on a small trolley on wheels, so as to be moved easily from place to place by members of the cane cutting gang), the man draws the "Acuto" along the edge of the blade towards him, thus shaving off one side of the edge. Then the same thing is done to the other side of the edge of the blade, using the other slot of the sharpening device (both of which are clearly seen in the illustration). No very great pressure need be used, and the result of a few strokes is a very keen cutting edge, which has the same degree of sharpness along the whole of the blade.

This sharpening is accomplished in a fraction of the time, with a fraction of the steel, and by a fraction of the energy, compared with the somewhat wasteful means of using a grindstone. When the hard steel disc is worn (which takes a long time as can be revolved to expose a fresh part of its edge) it can be instantly removed by undoing the screw shown, and substituting a new one.

This is an invention, the practical utility of which must be apparent at once to all. It should fill a long-felt want for an efficient and economical sharpener, and it is expected to be largely in demand for cane cutting, and for other crops using similar harvesting implements.

The "Acuto" costs only about 2s. (or 50 cents.) each and weighs about 1 lb. each, unpacked. Its great utility under any particular conditions can easily be demonstrated by ordering a few dozen for dispatch by parcel post for trial by the cane gang.

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[1] This apparatus is marketed in the cane sugar industry by The Sugar Manufacturers' Supply Co., Ltd., 2, St. Dunstan's Hill, London, E.C.3 (Cables "Sumasuco, London.")

Brevities.

It will be remembered that **Pasteur**, in his classical experiment on alcoholic fermentation, had observed that the gas evolved contained constituents other than CO_2. This residuum he thought to be nitrogen, but numerous later chemists who have studied the matter have not arrived at its exact composition. Now M. **Pictet** has identified the rare gas argon in it, using the spectroscope for doing so. His hypothesis to account for its presence is that it results from the disintegration of radio-active potassium, present in the salt nutrients used.

Referring to Dr. **Walter Mecklenburg**'s interesting article on the influence of the water content of a decolorizing carbon on its adsorbing power,[1] it should have been mentioned that this was a contribution from the Central Laboratory for Inorganic Chemistry of the firm, Verein fur chemische und metallurgische Produktion, in Aussig a. E., Czecho-Slovakia, which firm was formerly known as Österreichischer Verein fur chemische und metallurgische Produktion, the manufacturers of the well-known highly active carbon, "Carboraffin," which at the present time is being applied in the Continental beet sugar industry.

We regret to notice the death of Mr. **Wm. G. Kay**, C.B.E., one of the leading men in the public life of Trinidad. Mr **Kay**, a native of Glasgow, had been connected with the Caroni Estates since 1891, formerly as engineer, and more recently on the reconstruction of the company (the Caroni Sugar Estates (Trinidad), Ltd.) as Attorney and General Manager. He identified himself prominently with the commercial and industrial affairs of the Island, and did much towards furthering its interests He was a member of the Legislature for many years, and will be remembered as a highly respected member of the community of Trinidad.

quids, H. A. **Ellis**, M.B., Ch. B., uses a convenient modification of the colorimetric method. He follows the usual procedure of comparing the colour of the sample treated with the indicator with those of a series of standard buffer solutions. But instead of employing test-tubes the standard consists of small sealed capillary tubes, three of each of which fastened side by side on a card produce the appearance of a thin strip of colour about ¼ in. wide. Each card has a series of such sets of tubes fixed to it, covering the whole range of *pH* of a particular indicator, and each set differs from those on either side of it by 0·2 of a *pH* value. This "Capillator" has been put on the market, and for routine work should be of some convenience.

We are sorry to record the death on August 17th of Mr. **Thomas Steel**, F.C.S., F.L.S., who until his retirement about six years ago held an important position with the Colonial Sugar Refining Co., Ltd., of Sydney, Australia. Mr. **Steel**, who was 66, was born in Gourock, Scotland, and received his early training under the late **Thos. R. Ogilvie**, of Greenock. He was a man of strong individuality, and marked ability. Besides being an able research chemist, he was well known as the publisher of many contributions on natural history subjects. He did not publish extensively on sugar chemistry, but three of his recent contributions, on analyses of Fijian wild canes, etc.,[2] on abnormal sugar cane,[3] and on the nectar of flowers,[4] will be in the memory of our readers.

Mr. **Herbert Walker** stated at one of the meetings of the Philippine Sugar Association[5] that the Richardson Scale Co. believe that their "Apron Feed" automatic apparatus should give satisfactory results in the weighing of bagasse. This device is similar to the automatic sugar scale of the same company, with a short belt conveyor, instead of the upper hopper. When the scale hopper fills up and balances, it throws out a clutch on the belt conveyor, stopping momentarily the feed of the bagasse, and dumps automatically. Then as the empty hopper rises, it throws in the conveyor clutch again. If a really satisfactory scale could be developed for dealing with this material it would be worth while to install one in every factory; because, although it would not actually "put more sugar in the bags," it would remedy a weak link in chemical control, viz., calculating the weight of bagasse from the fibre determination.

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[1] *I.S.J.*, 1924, 368. [2] *I.S.J.*, 1922, 218. [3] *I.S.J.*, [illegible] [4] *I.S.J.*, 1925, 168.

[5] Reports of the Second Annual Convention of the Philippine Sugar Association, 1924, page 123.

Review of Current Technical Literature.[1]

Application of the Bach Process in Mauritius for the Production of White Sugar. *Louis Baissac. La Revue Agricole de l'Ile Maurice, 1925, No. 19, 375-377.*

Hitherto (excepting after carbonatation), the filtration of the syrup between evaporators and pans has not been performed economically, probably owing to the lack of a filter capable of dealing with the viscous liquor. But Bach's process[2] promises to make this possible, the procedure being briefly to treat the hot syrup leaving the evaporators with lime applied in the form of a thin stream of milk at 15° Bé. at the rate of 25-30 litres per 100 litres; pass in sulphurous acid simultaneously until neutrality to phenolphthalein, heat to 80-90° C., and then pump the syrup through the presses. This process has been applied in Java in several factories and in a refinery, but has been almost entirely abandoned there, because in the factories the sugar made was not much better than the product of simple sulphitation, whilst the cost of manufacture was greater, and because in the refinery the yield was low, probably on account of inversion. In both cases the syrup before entering the pans was sulphited to 0·6-0·9 grms. of SO_2 per litre. Bach's process was tried out in Mauritius in 1923, at first following the procedure given above, while adding a little kieselguhr before filtration. But great difficulties were experienced from the start, partly mechanical, since the installation used was equipped for raw juice; and partly technical, since when the syrup had an acid reaction it filtered readily, but with inversion; whereas, when neutral to phenolphthalein, filtration was almost impossible. Later the mechanical difficulties were surmounted, but the problem of filtration persisted after trying the effect of increasing or diminishing the amount of lime and of adding more kieselguhr. It was not until control according to the *pH* concentration was tried that the process was put in order, the results being rapid filtration, no inversion, good cakes, neutral and limpid syrup, and sugar of beautiful quality. From experience acquired with the process, it appears to be a delicate one: the reaction of the syrup at the moment of filtration must be very close to absolute neutrality, i.e., *pH* 6·8-7·0, and must not exceed it. Addition of the milk-of-lime must be made simultaneously with that of the sulphurous acid, the "reaction" throughout being kept near to *pH* 7·0. Nevertheless, because the sugar made thus in the Mauritius factory in question did not bring a higher price than the product of other factories in that country, and because its application raised the cost of manufacture, it was not continued But the author considers the process to be a good one, capable of giving excellent results. Under Mauritius conditions, it might successfully be applied by turbining roughly the sugar obtained from the second massecuites, re-melting this in defecated juice, adding this re-melt to the evaporator syrup, and then submitting the whole to the Bach sulphitation treatment as described.

Colour "Comparator" for the Determination of Hydrogen-ion Values. *George P. Meade and Rene Baus*[3] *La. Planter, 1925, 74, No. 26, 509.*

As a measure of the reaction of light-coloured solutions the colorimetric determination of the *pH* concentration offers many advantages over the older methods of test papers and titrations. It gives the effective acidity (that is, the inverting power) rather than the total acidity; besides which the procedure is simple; the numerical expression, or *pH* number, is quickly understood by untrained men; and the determination can be carried out as easily by artificial light as in daylight. The colour "Comparator" here shown was devised by the authors for routine tests. It consists of a sliding tube rack fitted with fixed tubes containing the colorimetric standards, these tubes being alternated with tubes of distilled water. Immediately in front of the sliding rack are sockets for two removable tubes, spaced the same distance apart as the tubes on the sliding rack, which tubes are for the solution to be tested, as will be explained later. A thin metal casing covers the tube rack, and serves to keep the light away from the standards. Suitable apertures in this cover permit sighting through the front tubes and the standards, and thence through a ground glass in the back of the cover. The bromthymol blue standards which have a *pH* range of 6·0 to 7·6 suit the purposes in the refinery, as the washed sugar liquor is held as close to the neutral point (7·0) as possible. These standards are made up in integers of 0·2 *pH* by mixing the corresponding buffer solution with 0·5 c.c of bromthymol blue 0·04 per cent., and, properly sealed, they last several months. It is obvious that the "Comparator" can be used for other *pH* ranges by the substitution of suitable standards. In making a test, 5 c.c. of the liquor or syrup to be tested is diluted with 15 c.c. of distilled water and 10 c.c. of this mixture is added to each of the front tubes of the "Comparator"; 0·5 c c. of bromthymol blue solution (0·04 per cent.) is added to the left-hand tube (*A*), the right-hand one (*B*) being kept as a blank Now the comparison is made by sliding the tube rack back and forth until the proper standard to match the test sample comes behind the blank (*B*). Thus any colour and turbidity which may be in the blank is added to the colour of the standard and compensates for that in the test solution. The tube of distilled water which is behind the test solution (*A*) compensates for the water in the blank. This is the Walpole method of comparison and the results are very accurate. With this "Comparator" any non-technical man of ordinary intelligence can make a test in a few seconds with an accuracy of 0·1 *pH*.

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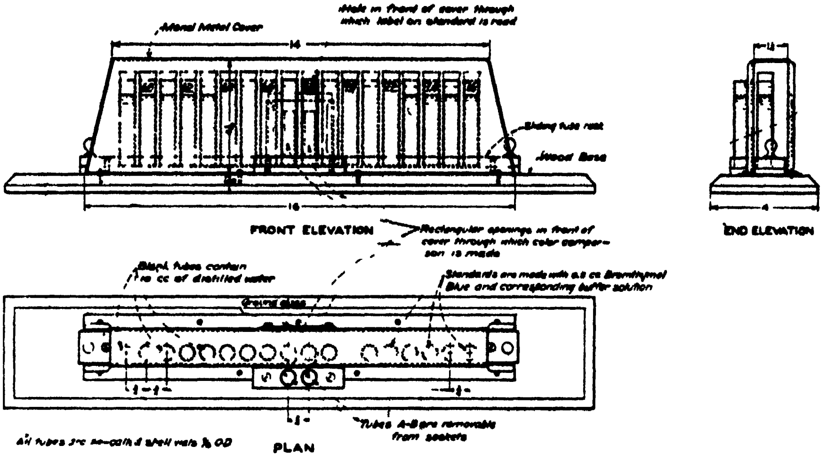
[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.* [2] *I.S.J.*, 1914, 390. [3] Of Colonial Sugars Company, Gramercy, La.


Monel Metal Cover
Hole in front of cover through which label on standard is read
14
Sliding tube rest
Wood Base
16
FRONT ELEVATION
Rectangular openings in front of cover through which color comparison is made
END ELEVATION
4
Blank tubes contain 10 cc of distilled water
Standards are made with 0.5 cc Bromthymol Blue and corresponding buffer solution
Ground glass
Tubes A-B are removable from sockets
All tubes are non-cath'd shell vials ⅝ OD
PLAN

Carbonatation Process at Mount Edgecumbe, Natal. *W. A. Campbell. Proceedings of the Third Annual Congress, Natal, March, 1925.*

Mr. Campbell explained that "do what we could, and armed with the very best advice to be obtained from England, Mauritius, and Java, our losses in the treatment of juice compared most unfavourably with the rest of the sugar countries of the world," the production of a uniformly white sugar from Uba cane being, moreover, impossible. On the suggestion of Dr. Shack-Sommer, and assisted by Messrs. Mitchell and Wuthrich, the carbonatation process was installed, some particulars of which, supplementing those already given,[1] are here submitted. A Belgian kiln of standard design, burning 40-50 tons of limestone per day continuously throughout the season, was fed with coke in the proportion of 9 per cent. of the stone added. In the operation of the process, mill juice was heated to 140° F. (60° C.), and limed and carbonated simultaneously (thus obviating the frothing that arose in intermittent operation, and was lessened to some extent by preliminarily "gassing" the juice with the excess CO_2 from the carbonatation tanks), the amount of lime added being about 12 per cent. (by volume) of milk at 15° Bé. Due to its porous nature, the cake obtained on passing the treated juice through filter-presses could be washed down to a sucrose content of about 0·5 per cent, and after this filtration the juice was submitted to a second carbonatation to adjust its alkalinity to a suitable degree. Following this it was heated to 165°F. (74°C.), filtered, sulphited, heated to boiling point, and again filtered, after which it went to the triple effect to have another filtration in the syrup stage before going to the pans. Advantages attributed to this process in comparison with the sulphitation formerly applied are: A much improved quality of sugar; an increased yield of it; and a larger boiling house and centrifugal capacity, some comparative figures given being as follows:—

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[1] *I.S.J.*, 1920, 267; 1922, 245, 607; 1923, 634; 1924, 29, 600.

	Carbonatation.		Sulphitation.
Rise of purity, raw juice to syrup.. ..	4·0 to 6·0	..	0·5 to 1·5
Gallons of molasses per ton of cane	4·0 to 5·0	..	6·0 to 7·0
Sugar lost in molasses, per cent. sugar in juice	8·0 to 11·0	..	13·0 to 14·0
Weight of scum cake per cent. cane.	10·0	..	3·5 to 4·0
Recovery of sugar in the bags, per cent. sucrose in the juice	83·0 to 84·0	..	73·0 to 77·0

USE OF PHOSPHORIC ACID ("SUMAPHOS") FOR THE CLARIFICATION OF SYRUP IN MAURITIUS. *A. E. Bérenger. La Revue Agricole de l'Ile Maurice, 1925, No. 18, 336–337; 1925, No. 19, 368-369.*

Phosphoric acid is generally used as a clarifier in combination with lime to produce a bulky precipitate for the entangling of the suspended matter and the colloids present in the juice or syrup. But it is now being used in Mauritius for the clarification of the syrup in white sugar manufacture in another way, viz., in the form of the free acid without the addition of any lime.[1] Its effect when thus applied is obtained, first, by its action on colouring matters, which it gradually precipitates under the influence of heat in the form of a *lac*; and, second, by its effect in producing an acid reaction without danger of inversion. In these two articles the author gives the results of his studies to establish the optimum conditions for use in this way. In experiments carried out in the laboratory, 7 litres of the syrup were heated to temperatures from 70 to 90° C., treated with 16 c.c. of a decanted solution of superphosphate at 10° Bé. (this corresponding to half a litre per barrique),[2] and the mixture allowed to stand for 15 hours while cooling slowly, thus imitating as closely as possible factory practice. Herewith are the results of his analyses of the syrup before and after treatment.[3] It can be concluded from these that, beginning with 70° C. there is a gradual rise in the purity as the temperature is increased, and it was also observed that at the same time the settling gradually improved, until 80 to 82° C. was reached. After that degree the precipitate became flocculent, and settled less well. On further raising the temperature to 90° C. there was a loss of purity, and an increase of the

	CONTROL TEST.				ANALYSES AFTER DECANTATION			
No.	Density at 20° C.	Purity.	Glucose Ratio.	Temperature.	Purity.	Glucose Ratio.	Gain or Loss of Purity.	Decolorization.[4]
1	1271·8	86·1	3·6	70° C.	86·4	3·6	+ 0·3	1 : 1·5
2	1271·8	86.1	3·6	80° C.	86·8	3·6	+ 0·7	: 2
3	1271·8	86·1	3·6	90° C.	84·5	3·9	— 1·6	1 : 3
4	1259·8	85·5	4·1	70° C.	86·0	4·0	+ 0·5	: 1·5
5	1259·8	85·5	4·1	80° C.	86·5	4·2	+ 1·0	: 2
6	1259·8	85·5	4·1	90° C.	84·5	4·7	— 1·0	: 3
7	1216·5	86·1	4·8	70° C.	86 5	4·75	+ 0·4	1 : 1·5
12	1225·8	84·8	4·0	80° C.	85·8	3·9	+ 1·0	: 2
15	1227·0	84·7	3·7	90° C.	85·5	4·3	— 0·8	: 3
18	1219·7	84·2	4 4	80° C.	85 57	4·4	+ 1·37	: 4
19	1219·7	84·2	4·4	80° C.	85·53	4·3	+ 1·33	: 5

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[1] *I.S.J.*, 1923, 150. [2] "La barrique" corresponds to 50 gall., 8·02 cub. ft., or 227·17 litres.

[3] Eight of the 19 tests reported are here omitted.

[4] A decolorization of 1 : 3, for example, indicated that the untreated syrup had been diluted with twice its volume of water to give a liquid having the same colour as the treated liquid.

glucose ratio, indicating the beginning of the inversion of sucrose, though the *pH* value was 6·0. In tests 18 and 19 the amount of superphosphate solution was 24 and 28 c.c., instead of 16 c.c., as in the others, and it was found that the decolorisation was in proportion to the amount of the acid added, while there was also a rise in purity. Nor did inversion occur with this comparatively large dose of phosphoric acid, the *pH* values being 6·3 in both tests. Nevertheless, it is considered unnecessary in practice to use these high amounts, quite a sufficient effect being obtained with half a litre per barrique and a temperature of 76 to 82° C.

In the second article, results obtained in the factory using "Sumaphos" are reported. Syrup on leaving the evaporators was gradually mixed with a solution of "Sumaphos" at the rate of 180 to 220 grms. of the chemical per ton of cane ground, re-heated to 80° C., and sent to the decanting tanks. It was observed that decantation was better when the "Sumaphos" was added before the reheating than after; that it was not possible to record any increase of the glucose ratio, the *pH* averaging 6·3; that the purity of the decanted syrup was always slightly higher than that of the syrup before the treatment; and also that the decolorization was as good as that obtained in the laboratory experiments recorded above. In fact, the results found in the laboratory were in general confirmed by these factory trials. Attention of those interested in this mode of clarifying syrup is called to the necessity of thoroughly mixing together the syrup and the solution of "Sumaphos," and this in as short a period of time as is possible. This can best be realized by adding the clarifier little by little to the syrup as it leaves the evaporator, then raising the temperature to the degree named in any type of re-heater permitting rapid circulation. In this way the acid has not merely a local action, but is well distributed throughout the whole of the syrup. This mixing is done at a relatively low temperature, namely, 55 to 60°C.

REFINING WITH DECOLORIZING CARBON ("SUCHAR"). **Leonard Wickenden.**[1] *Chemistry and Industry, 1925. 44, No. 34, 848-849.* Replying to Keyworth's remarks,[2] it is said: "With regard to high original cost . . . . . the furnace used in the revivification of "Suchar" has solved this problem with complete success, ... the cost of revivification and of replacing the slight loss is reduced to the low figure of 2s. 3d., or less, per ton of sugar."—TIME OF YEAR TO PLANT MOTHER BEETS FOR SEED PRODUCTION. **Dean A. Pack.** *Journal of Agricultural Research, 1925, 30, No. 9, 811-818.* The early spring is decided to be the best time for a variety of reasons, such as: food mobilisation, foliage development, new root production, and soil nutrient absorption, each of which conditions is studied in detail here.—ALCOHOL PRODUCTION, USING PURE YEAST CULTURES. **Albert Meijer.** *Archief, 1925, 33, No. 25, 562-563.* An average yield of alcohol equivalent of 60-61 litres of 100 per cent. G.L., also carbon dioxide equivalent to 40-45 kg. per 100 litres of 100 per cent. alcohol, can be realized under the pure yeast culture system. CO_2 produced is as pure as that made in the chemical way, owing to the absence of by-products arising from the growth of foreign yeasts and bacteria.—LOSS OF POLARIZATION OF BEETS DURING STORAGE IN SILOS. **D. Simmich.** *Vereins-Zeitschrift, 1925, No. 826, 493-503.* After 24 hours the polarization had fallen only 0·06 to 1·10° V, and most of this loss was only apparent, due to the roots having taken up water while swelling; during which time the invert sugar had remained practically unchanged. After 48 hours the fall of polarization was only slightly greater.—DISTILLERY WASTE LIQUORS AND THEIR PURIFICATION. **Robt. D. Littlefield.**[3] *Chemistry and Industry, 1925, 44, No. 35, 860-867.* Method of purification adopted was based on Dr. G. McGOWAN's observation that, provided a sufficient time for passage through a filter be assured, almost complete oxidation of the organic matter in an effluent can be effected, once the suitable bacteria were established in the filter. This process was applied successfully to steep-water, pot-ale, spent-lees and wash-waters.—APPLICATION OF DECOLORIZING CARBON TO SUGAR REFINING. **C. M. Keyworth.** *Chemistry and Industry, 1925, 44, No 23, 869-870.* A comparison of kieselguhr and decolorizing carbon frequently shows surprising results; for, though each should equally lose its filtration efficiency with the same sugar solution, this does not often happen, sometimes the one, and sometimes the other being the better. A mixture of kieselguhr and decolorizing carbon gives good filtration results. It is certain that as details of application and revivification are improved that these carbons will gradually oust bone charcoal.—CARBOHYDRATE STUDIES: RELATIVE SWEETNESS OF PURE SUGARS *Alice Biester, Mildred Wood, and Cecile S. Wahlin.*[1] *American Journal of Physiology, 1925, 73, No. 2, 387-395.* Method of comparison was to establish the minimum concentration declared sweet by at least 20 persons, when, with sucrose as 100, the following was the numerical rating:—Levulose, 173·3; dextrose, 74·3; xylose, 40·0; maltose and rhamnose, both 32·5; galactose, 32·1; raffinose, 22·6; and lactose, 16·0.—CARBOHYDRATE STUDIES: RELATIVE SWEETNESS OF SUCROSE AND INVERT SUGAR. *J. J. Willaman, Cecile S. Wahlin, and Alice Biester. American Journal of Physiology, 1925, 73, No. 2, 397-400.* Assigning to sucrose the value of 100, and taking into account the fact that 100 of sucrose yield 105 parts of invert sugar, then the value for invert sugar made from sucrose by hydrolysis with the enzyme invertase is 127·4, and for that made by the solution of equal weights of dextrose and levulose is 130 0.—MOTOR FUELS. *J S. S. Brame. Journal of the Royal Society of Arts, 1925, 73, 920-929, 930-940, 942-953.* This is one of the Howard Lectures, delivered before the Society of Arts, London, and dealt *inter alia* with:—Future supplies; "cracked" spirit; "casing head" spirit; motor benzol; power alcohol; fire risks with motor fuels; physical properties of motor fuels; boiling range; explosive range; and calorific value; fuel and air mixtures, composition of fuels and efficiency; Ricardo variable compression engine; "anti-knock" compounds; mixed fuels.—MEASUREMENT OF HYDROGEN-ION CONCENTRATION. *E. B. R. Prideaux. Journal of Scientific Instruments, 1924, 2, No. 2, 33-38; 1925, 2, No. 4, 113-118.* After a brief summary of the methods used for determining hydrion concentration, the scopes of the conductivity and hydrogen electrode methods are defined, the latter being described in detail. Experimental manipulation is described under: electrodes, cells, potentiometers, and null point indicators.—WESTLY REPLIES TO PETREE AND DORR ENGINEERS. *E. T. Westly. Sugar News, 1925, 6, No. 6. 250-351.* Mr. WESTLY remarks that he is not the only one who feels that the Petree-Dorr factories report too high recoveries, and cites Mr. W. R. MCALLEP who has stated *inter alia* that "the result is that in the Petree process a loss that would otherwise occur in press-cake is transferred from the filter-presses to the mill, where it does not appear as a loss, but instead reduces the amount of sugar that otherwise would be credited to the cane."—COMMENTS ON THE PETREE-DORR PROCESS. *Wm. Wyllie. Sugar News, 1925, 6, No. 8, 478-479.* Author had stated in connexion with milling that the return of mud to the mills accompanied by considerable quantities of juice causes a reduced extraction, and now remarks that "apart from milling criticism and control referred to, I wish to give the system credit where it is due, especially to the Dorr clarifiers, which if manipulated properly produce brilliantly clarified juices Two men per shift look out for the station, which is inexpensive in maintenance; and in operation, simple, clean, and sanitary."—REFINING TESTS OF PHILIPPINE SUGARS. *Herbert Walker. Sugar, 1925, 6, No 8, 452-454.* Analyses of 12 Philippine sugars show filtration rates from 33 to 74 per cent., insoluble matter from 0·01 to 0 10 per cent., and clarity, from 16 to 48 mm. Hawaiian sugars lately showed an average filtration rate of 72·3 per cent. in 1923, and 80·6 per cent. in 1924, whereas the average of the Philippine sugars here examined was 57·0 per cent—RECENT PROGRESS IN THE CHEMISTRY OF PECTIN AND ITS INDUSTRIAL APPLICATIONS. *W. H. Dore. Ind. Eng. Chem.*, through *La. Planter, 1925, 74, No. 25, 490-492.* This article reviews recent work on the chemistry of pectins, especially that of VON FELLENBERG, on the probable mechanism of the formation of fruit jellies, and discusses the present application and probable uses of pectin. Beet pulp constitutes an immense potential source of this product, but, as at present the supply exceeds the demand, any great expansion of the industry must depend on the discovery of new uses for pectin.

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[1] Chemist to the Suchar Process Corporation. [2] *I.S.J.*, 1925, 504. [3] Ministry of Health, London.

J. P. O.

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[1] Division of Home Economics, University of Minnesota.

Review of Recent Patents.[1]

UNITED STATES.

PRODUCTION AND APPLICATION OF DECOLORIZING (ACTIVE) CARBON. *Christian J. Gambel*, of New Orleans, La., U.S.A. (*A*) *1,528,370*. March 3rd, 1925. (*B*) *1,528,371*. March 3rd, 1925.

(*A*) Whatever may be the physical action of decolorising carbon, the inventor has discovered that if one mixes a decolorizing material with a filtering material, as by finely subdividing both materials, and making a filtering and decolorizing mixture thereof, that not only will the fluidity of the sugar solutions treated be greatly increased over what would be the sum of the independent actions of each, but the decolorizing power of such a mixture will also be very much greater than will be the combined decolorizing powers of the two materials acting separately. Thus one may take five parts by weight of a decolorizing carbon (i.e., that made from rice-mills), and pass through it for a period of, say, ten minutes, 100 parts by weight of a given sugar solution. At the end of the ten minutes the sugar solution will be decolorized to a degree which may be called 100 per cent , or it will be decolorized to such an extent that perfect white sugar could be made therefrom. Let us take this same raw sugar solution, and the same carbon; mix with the carbon, say, 20 per cent. or more of filtering material such as kieselguhr, the two being very finely subdivided and thoroughly mixed; and pass the 100 parts of the sugar solution through the 6 parts of the mixed filtering and decolorizing material produced as above. We will find that the same degree of decolorization will take place in, say, from 3 to 5 minutes. Also, that if we pass this same sugar solution first through the filtering material consisting of kieselguhr, and then immediately through the 5 parts of the decolorizing carbon, the same amount of decolorization would require if not 10 minutes, very nearly that period of time. In other words, by mixing the two materials together, the time has been reduced by 25 to 50 per cent. of that required when no mixture is used. By pursuing the method above outlined one can use less decolorizing carbon in the mixture, and thus save in the cost of the carbon used.

(*B*) It is now well known that if rice hulls and other fibrous rice materials are carbonized out of contact with the air, and then boiled in caustic soda until a material proportion of their silica content is dissolved out, the resulting carbon will, when finely ground, possess a decolorizing power for sugar and other liquors which is many times that of boneblack. But in the first place, rice hulls, the most desirable material, are individually very light, and it has been found a very serious problem to find a furnace which will thoroughly carbonize them. If too much air is admitted to the furnace, the rice hulls being very easily consumed, will be partially or wholly destroyed for the purpose in hand; and if too little, it is found very difficult to maintain such a temperature in a furnace of the required size as will uniformly and thoroughly carbonize the said hulls. Further, when the air entering a furnace of a commercial size has been adjusted for one car load of hulls, it may be found to operate very inefficiently for the next car load, owing to the difference in the moisture present. That is, if the heat given off by the combustion of the first dry car load is just right to maintain the proper carbonizing temperature, a car load having a larger moisture content will burn at a temperature too low for a successful carbonization. From the foregoing it will now be clear that in practising this invention one first separates out from the hulls the trash, fine dust, and other impurities which do not form good decolorizing material, and next deprives the cleaned hulls of their moisture content, so that they may be uniformly carbonized in a rotary furnace of suitable type. It is important that after the hulls are uniformly dried so that they will be uniformly carbonized in the furnace, a substantially predetermined uniform quantity of the hulls should be continuously fed to the furnace. This predetermined quantity is readily obtained by the screw conveyers and other mechanism. After the hulls have been thus uniformly carbonized through a destructive distillation without burning up their valuable cellulosic carbon, they should be ground not only to facilitate their subsequent treatment with caustic soda, but to render them more efficient in the process of decolorizing sugar solutions. The carbonized hulls or char as it comes out of the furnace is not only very hot but it is very light and fluffy, and consequently exceedingly difficult to handle. Therefore, the cooling apparatus and screw conveyers enclosed in iron pipe are provided to insure that this very light carbon is kept under control at all times. The same remark applies to the ground carbon after it leaves the grinding mill. Some of it is in the form of a very fine dust, while other portions thereof are too coarse to be satisfactory in practice. Consequently, the coarse particles are returned to the circulation as disclosed, and reground, while the finely ground carbon is carried on to the caustic soda tanks, in order to partially remove their silica content. It is a problem not to only get this very fine impalpable dust-like carbon into the said tanks, but it is also a problem to get it thoroughly mixed with the caustic solution therein. It has been found that the most convenient way is by sluicing the finely divided carbon out of the trucks containing the same with water, and thus forcing it into the tanks. Wherever a thorough mixture between the finely divided carbon and the liquid is desired, agitators are provided. It has been found not only desirable but almost essential to wash the finely divided carbon one or more times after treatment with caustic, to further wash the carbon after treatment with acid, and then to still further heat the carbon in order to drive off the last traces of acid, which seem to impregnate the very fine microscopic pores with which the finished carbon is provided. It is very desirable that no acid decolorizing material be introduced into sugar solutions. Carbon washed after the acid treatment may show a neutral condition to chemical indicators and yet contain appreciable quantities of acid The most efficient method for getting rid of the last traces of acid is by means of a reheating process, after the carbon has passed the caustic soda and acid tanks. The finished carbon, after this reheating, is found to be very efficient in the decolorizing of sugar solutions and other liquids.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris.

JUICE CLARIFICATION WITH ALGINATES.[1] *Eloi Ricard*, of Melle, Deux-Sevres, France. (*A*) *1,515,968.* November 18th, 1924. (*B*) *1,538,003.* May 19th, 1925.

(*A*) Claim is made for the process of purifying liquids of various kinds, which consists in adding a water-soluble alginate to the liquid, and means to precipitate alginic acid, so as to form a coagulating and clarifying precipitate in the mass of the liquid. (*B*) Claim is made for the process of purifying liquids of various kinds, which consists in adding a water-soluble alginate to the liquid, and then adding lime to precipitate an insoluble alginate so as to form a coagulating and clarifying precipitate, then separating this precipitate from the liquid in order to obtain a filter-cake having elementary or fertilizing properties.

PRODUCTION OF BONEBLACK, USING STEAMED BONE. *William Jones* (assignor to *Vesta M. Jones*, of New York, U S.A.). *1,518,072.* December 2nd, 1924.

In the production of boneblack, the inventor uses steamed bone (bone after the gelatine and carbon have been separated and practically all the nitrogen also removed) is ground, mixed with the required amount of a carbonaceous substance capable of producing an active carbon when calcined, e.g., ground hard pitch or asphalt, and this mixture calcined out of contact with air.

SYRUP MANUFACTURE. *Ronald J. Slay*, of Hattiesburg, Miss., U.S.A. *1,532,271.* April 7th, 1925.

Claim is made for the process of treating the juice of cane in the production of syrup, consisting in determining the amount of sucrose contained in the juice, adding to it not less than 2½ per cent. of tartaric acid (of the amount of sucrose present), boiling the juice for not less than one hour, and substantially sterilizing it.

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[1] See also U.K. Patents, 173,735 and 177,761; *I.S.J.*, 1922, 274 and 365.

Settling Tank for Defecated Cane Juices.[1] *Charles W. Ruckstuhl*, of New Orleans, La., U.S.A. *1,543,621.* June 26th, 1925.

This invention contemplates the provision of: (1) A simple and inexpensive device having a series of shelves so constructed and arranged that a larger settling surface is provided in a smaller tank unit; (2) A settling tank that permits of the ready withdrawal of the clear juices and at the same time allows removal of mud and sediment from the most inaccessible point of the tank, viz., the lower end thereof; and (3) A tank for continuously separating fibre and other lighter substances as well as heavy foreign substances from saccharine liquids. It comprises the cylindrical tank *1* funnel-shaped in cross-section at its lower end *2*; and at the ends of which a mud outlet *3* is provided, and also a manhole cover *4* whereby access to the lower end of the tank may be had. At its upper end, the tank *1* is provided with the inverted funnel-shaped portion *5*. At its extreme upper end, it is open and arranged over said opening is a scum overflow trap *6* that has a scum outlet at *7*. Adapted to enter the tank (preferably at the inverted cone-shaped portion *5*) is a charge pipe *8* that is in direct communication with a series of baffle plates *9*. These are open at their lower ends *10*, and are permanently secured to the walls of tank *1* extending completely around the inner surface of the tank. The plates are of funnel-shaped construction in cross-section, and the wall of each succeeding one is arranged so as to produce a comparatively larger opening *10* at its base than the opening of the plate immediately above. In order to permit the cleaning of the various shelves or baffle plates, a number of hand-hole plates *12* is provided. A flange *13* is provided to permit the tank to rest upon a foundation. A draw-off pipe *11* is provided in the portion *2* of the tank. In the operation of settling, fermentation sets in, and it becomes necessary after a period of approximately six days to wash the tank and for this purpose, pipe *11* is used. The side walls of the tank *1* are provided with outlets that communicate with the spaces between each baffle plate *9*, and the outlets are in direct communication with the pipes *14* having cut-offs *15* and said pipes *14* terminate in pipes *16* that enter the tank *17*. In order to prevent the juices from leaving tank *17* in any other way than through the clear juice outlet *19*, the pipes *16* are provided with extensions which extensions in turn are provided with the members *18*.

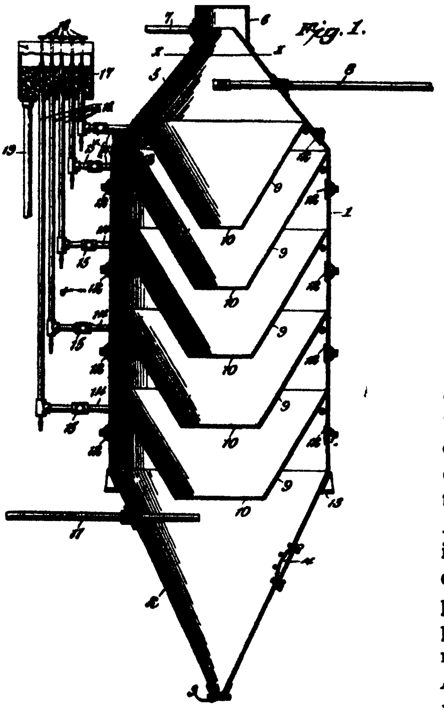
Fig. 1.

In the practical use of the invention the charge of dirty juice enters under pressure through pipe *8*, the tank being constantly maintained nearly full with liquor, during its operation. The dirty juice flowing downward, the mud and heavier particles continuing down through openings *10*, while the clear juice starts up under plate *9* toward outlets *14*. The gums, waxes, and lighter particles are carried to the surface of the liquid, which is maintained somewhere in the neigbourhood of the line *X*, and from there is carried over into scum collector *6*. The clear juice passes through pipes *14* and *16*; up through sleeves *20* overflowing into tank *17*; and is drawn from *17* as fast as it enters by clear juice outlet *19*. In order to maintain the surface of juice at line *X* so that waxes and scums will push themselves out over the top into scum collector *6*, the sleeves *20* are raised or lowered, thereby regulating the head pressure between the two levels. It can easily be seen that by raising the sleeves *20* and thereby bringing the overflow to a higher level the surface *X* in the tank will be raised correspondingly. By maintaining the juice at a level *X* the gum and scums collecting at the top will be continuously working over the top of the inverted cone *5*, and the steam from the hot juice will bubble up and carry a great portion of the scum over with it. When it becomes necessary to overflow the tank the sleeves *20* are raised sufficiently to cause this overflow. If the juice flowing from one outlet is slightly dirty, due to the too speedy operation in this one compartment, the sleeve *20* which regulates the flow from this particular compartment will be raised in order to make the flow a little slower. In this way each compartment between the baffle plates *9* can be correctly regulated to their respective capacities and the whole regulated so as to maintain level *X* in the tank at the proper point.

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[1] *I.S.J.*, 1923, 502; 1923, 656; and 1924, 71.

UNITED KINGDOM.

PREVENTING BOILER CORROSION. *F. Hauptvogel*, of Vienna, Austria. *233,657*. February 20th, 1925; convention date, May 10th, 1924.

Boilers to be protected are connected in parallel with a direct current circuit, no electrodes being introduced into the boiler. The supply is preferably taken from the mains and a variable resistance used in parallel with a boiler. Fuses and indicating lamps are fitted. A second lamp may be fitted to the other lead of the shunt circuit.

ALCOHOL MOTOR FUELS. (*A*) *E. Terry*, of Clapham Park, London. *230,354*. August 15th, 1924. (*B*) *E Urbain and R. Urbain*, of Paris. *230,590*. January 23rd, 1924

(*A*) Motor spirit consists of acetone and a light hydrocarbon, such as benzole, gasolene, kerosene, naphtha, or paraffin. In examples, 25–30 per cent by volume of acetone is used. (*B*) Vapours of aqueous alcohol are submitted to atmolysis through a porous partition such as a tube of pipe earth or graphite. Vapours containing a greater proportion of water pass through the partition.

PRODUCTION AND APPLICATION OF ACTIVE (DECOLORIZING) CARBON. (*A*) *J. N. A. Sauer*, of 2, Den Texstraat, Amsterdam, Holland. *236,984*. April 5th, 1924.

Active carbon is produced in a portable retort comprising a shaft provided with means for injecting a blast of gas and having a base fitted with wheels The process of activating granular carbonaceous material described in Specifications 206,862[1] and 228,582[2] and also the apparatus described in the latter Specification when made portable may be employed. The retort, which may consist essentially of a steel casing lined with fire-brick or magnesia, may be vertical, inclined or horizontal, and an inner tube or frame may be provided to strengthen it. When the inner tube is constructed so that it is not removable it may be made of a resistant alloy. Alternatively the retort itself may be made of such an alloy, a jacket of asbestos being provided. On the retort base may be mounted a generator for producing the activating gas, e.g., gas from liquid fuel such as crude oil or petrol, and also apparatus for pre-distilling or charring the raw carbonaceous material. The generator may serve both for pre-distilling and charring the raw material and also for supplying the activating gas. In a further modification the retort may be associated with appliances for water-purifying and for treating the carbon produced. The water-purifying apparatus may comprise an enamel-lined steel container provided with a water inlet and outlet, a porous pot being fitted over the latter. Water enters at the bottom of the container, mixes with the carbon and leaves at the top. To ensure that bacteria are entirely removed, the water may also be passed through a suction-filter or a filter-press containing layers of the activated carbon. Carbon specially suitable for this purpose is obtained by treating without subsequent washing the active carbon with acid, e.g., hydrochloric acid in the sterilizing apparatus. When washed with water the carbon after the acid treatment is available for medicinal purposes.

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[1] *I.S.J.*, 1924, 169.

[2] *I.S J*, 1925, 280.

PRODUCTION OF ALCOHOLS, ETC. (*A*) *J. Y. Johnson* (communicated by the *Badische Anilin & Soda Fabrik*, of Ludwigshafen, Germany). *237,030*. April 28th, 1924. (*B*) *W. Freiburg*, of St. Louis, Missouri, U.S.A. *237,228*. June 9th, 1925; convention date, July 17th, 1924.

(*A*) Catalysts for the production of oxygenated organic compounds, particularly methyl alcohol, by the interaction of oxides of carbon with hydrogen at an elevated temperature and under pressure comprise a mixture of two or more metals the oxides of which can be reduced to the metal by hydrogen or carbon monoxide at ordinary pressure and at a temperature below 550° C. Iron, cobalt and nickel are excluded, as also are mixtures of the said two or more metals with metals of the 4th to the 7th periodic group or boron. Suitable metals are copper, silver, lead, zinc and cadmium; additions, such as potassium carbonate, may also be present and carriers may be employed. According to the example, a catalytic material is prepared by precipitating with potassium carbonate a solution of ten molecular proportions of copper nitrate to one molecular proportion of zinc nitrate, drying the precipitate, then making it into a paste with sugar and formaldehyde, and finally reducing the dried paste with hydrogen at a temperature of 250–300°C. Over the contact mass maintained at a temperature of 300°C., a mixture of carbon monoxide with excess of hydrogen is passed under a pressure of 150 atmospheres; methyl alcohol is condensed from the gaseous product. The carbon monoxide may be replaced by carbon dioxide, and other gases such as nitrogen may be present. Specification 229,715 is referred to. (Reference has been directed by the Comptroller to Specification 20488/13.)

(*B*) Acetone and butyl alcohol, together, it may be, with other neutral substances, are produced by fermenting carbohydrate or like material with an anaerobic bacillus, called *B. butylaceticum*, isolated as described below and characterized in that it has rounded ends, forms large resistant spores, and does not readily liquefy nutrient gelatine. To isolate the bacillus a substance such as grain or soil is added to sterile boiling water or heated in water to destroy non-sporing organisms and organisms forming only slightly resistant spores, whereafter an anaerobic culture of the surviving organisms is prepared by any of the usual methods. In use, a quantity of the culture is transferred to the hot, sterilized, fermentable substance, such as a mash of potato, rice, or maize, and the mixture incubated at 35–38°C. for about 24 hours. During the course of the fermentation the mash first becomes acid, with evolution of carbon dioxide and hydrogen, whereafter the acidity declines and neutral products such as acetone and butyl alcohol are formed. The fermented mash may be used to prepare further cultures or to inoculate further quantities of the fermentable materials. The products are recovered by distillation.

FILTERS. (*A*) *J. W. Hinchley and Stream Line Filter Co., Ltd*. *236,608*. March 4th, 1924. (*B*) *J. W. Douglas* (Executrix of *R. P. Douglas*) of Bolton. *236,720*. June 19th, 1924.

(*A*) Liquid is forced into a filter from a supply vessel by gas pressure, and the increased pressure of the gas in the supply vessel due to the clogging of the filter is used to operate a valve which admits gas from the supply vessel to the filter so that it passes in the reverse direction through the medium therein and drives out the separated solid matter through another valve simultaneously opened by the gas pressure. Filters as described in Specifications 210,101 and 210,376[1] are preferably used. (*B*) Rotary strainers comprising a vessel divided by radial partitions into compartments which is provided with sieves and rotates on a stationary hollow shaft slotted along its upper surface. Material is provided through a spout to the uppermost compartment, and the liquid therefrom is drawn away through the shaft, the solid matter being discharged from the compartment in the course of rotation which may be continuous or intermittent.

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[1] *I.S.J.*, 1924, 283.

Sugar Crops of the World.

(Willett & Gray's Estimates to September 24th, 1925.)

	Harvesting Period	1924-25. Tons	1923-24 Tons.	1922-23. Tons.
United States—Louisiana	Oct.-Jan. ..	79,002	144,664	263,478
Texas	,, ,, ..	450	2,500	2,875
Porto Rico	Jan.-June ..	589,288	399,975	338,456
Hawaiian Islands	Nov.-June ..	695,000	626,279	479,463
West Indies—Virgin Islands	Jan.-June ..	7,200	2,332	1,739
Cuba	Dec.-June ..	5,120,000	4,066,642	3,602,910
British West Indies—Trinidad	Jan -June ..	50,000	52,045	41,619
Barbados	,, ,, ..	53,000	44,109	52,715
Jamaica	,, ,, ..	42,600	33,431	33,029
Antigua	Feb.-July ..	14,500	7,860	12,642
St. Kitts	Feb.-Aug...	16,000	10,196	10,735
Other British West Indies..........	Jan.-June ..	9,000	4,488	5,292
French West Indies—Martinique	Jan.-July ..	23,000	17,110	19,700
Guadeloupe	,, ,, ..	34,000	27,548	25,043
San Domingo	Jan.-June ..	311,270	229,373	184,171
Haiti	Dec.-June ..	7,000	5,800	10,967
Mexico	,, ,, ..	165,223	166,932	149,338
Central America—Guatemala	Jan.-June ..	24,000	20,850	24,445
Other Central America	,, ,, ..	65,000	55,281	50,336
South America—				
Demerara	Oct.-Dec. and May-June ..	100,000	95,494	101,128
Surinam	Oct. Jan. ..	10,200	10,682	11,719
Venezuela	Oct.-June ..	19,000	17,488	16,840
Ecuador	Oct.-Feb. ..	18,700	13,662	14,220
Peru	Jan.-Dec. ..	300,000	326,352	320,445
Argentina (1925-26 : 300,000)	May-Nov. ..	246,000	249,162	209,718
Brazil	Oct.-Feb. ..	500,000	493,599	595,723
Total in America.......		8,499,433	7,123,854	6,578,746
Asia—British India (1925-26 : 2,502,000)	Dec.-May ..	2,537,000	3,317,000	3,044,000
Java (1925-26 : 2,240,000)	May-Nov. ..	1,977,490	1,771,772	1,746,875
Formosa and Japan (478,000)	Nov -June ..	469,787	448,736	405,800
Philippine Islands...............	,, ,, ..	550,000	372,332	263,437
Total in Asia..................		5,534,277	5,909,840	5,460,112
Australia (1925-26 : 500,000)	June-Nov. ..	435,680	281,859	306,678
Fiji Islands	,, ,, ..	70,000	58,000	37,154
Total in Australia and Polynesia		505,680	339,859	343,832
Africa—Egypt	Jan.-June ..	110,000	88,382	94,554
Mauritius (1925-26 : 206,000)	Aug -Jan ..	224,710	201,550	231,190
Réunion	,, ,, ..	43,500	44,132	42,872
Natal (1925-26 : 180,000)........ .	May-Oct. ..	143,974	181,571	142,287
Mozambique....................	,, ,, ..	55,000	56,400	45,950
Total in Africa		577,184	572,035	556,853
Europe—Spain	Dec.-June ..	10,629	7,871	13,918
Total cane sugar crops		15,127,203	13,953,459	12,953,461
Europe—Beet sugar crops		7,175,000	5,057,761	4,574,325
United States—Beet sugar crop	July-Jan. ..	974,185	787,217	615,936
Canada—Beet sugar crop	Oct.-Dec. ..	36,200	16,500	12,400
Total beet sugar crops		8,185,385	5,861,478	5,202,661
Grand total Cane and Beet Sugar	Tons .	23,312,588	19,814,937	18,156,122
Estimated increase in the world's production ..	,, ..	3,497,651	1,658,815	541,067

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending September 30th.		Nine Months ending September 30th.	
Unrefined Sugars.	1924. Tons	1925. Tons.	1924. Tons.	1925. Tons.
Poland	1,611	....	24,838	9,016
Germany	....	....	....	1,963
Netherlands	....	....	....	....
France	....	..	....	....
Czecho-Slovakia	77	. ..	20,207	1,031
Java	27,649	11,761	79,918	24,940
Philippine Islands	..	....	....	....
Cuba	51,360	43,057	414,222	584,478
Dutch Guiana	....	....	....	....
Hayti and San Domingo	2,989	7,421	101,373	129,296
Mexico	....	....	....	....
Peru	4,197	4,298	60,291	45,193
Brazil	....	....	22,328	6,540
Mauritius	110	150	93,144	16,611
British India	...	....	....	....
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	342	5,061	51,381	115,185
Other Countries	7,740	20,911	76,000	68,099
Total Raw Sugars	**96,075**	**92,659**	**943,701**	**1,002,353**
Refined Sugars.				
Poland	....	....	15,095	13,274
Germany	267	25	21,401	6,329
Netherlands	1,918	9,415	98,359	127,987
Belgium	844	304	21,338	13,014
France	....	....	.	....
Czecho-Slovakia	154	1,595	148,213	138,072
Java	....	....	....	....
United States of America	11,693	31,299	56,676	138,238
Canada	1,234	9,996	25,000	93,179
Other Countries	1,618	1,058	7,603	3,193
Total Refined Sugars	**17,729**	**53,692**	**393,685**	**533,285**
Molasses	219	5,830	139,431	130,853
Total Imports	**114,023**	**152,181**	**1,476,817**	**1,666,491**

EXPORTS.

British Refined Sugars.	Tons.	Tons	Tons.	Tons.
Denmark	3,054	33	5,744	766
Netherlands	128	35	598	193
Irish Free State	6,962	6,044	38,485	40,194
Channel Islands	90	73	814	667
Canada	....	....	....	...
Other Countries	2,738	474	9,906	6,768
	12,972	6,658	55,548	48,588
Foreign & Colonial Sugars.				
Refined and Candy	165	819	4,657	1,753
Unrefined	2,113	179	7,926	559
Various Mixed in Bond	....	....	....	....
Molasses	20	63	2,581	383
Total Exports	**15,270**	**7,719**	**70,712**	**51,283**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1925. Tons.		1924. Tons.
Total Receipts, January 1st to October 1st	2,721,837	..	2,582,994
Deliveries „ „	2,668,555	..	2,576,658
Meltings by Refiners „ „	2,598,580	..	2,517,710
Exports of Refined „ „	243,000	..	168,000
Importers' Stocks, October 1st	53,282	..	7,130
Total Stocks, October 1st	135,264	..	71,317
	1924.		1923.
Total Consumption for twelve months	4,854,479	..	4,780,684

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1922-1923, 1923-1924, AND 1924-1925.

(Tons of 2,240 lbs.)	1922-23 Tons.	1923-24 Tons	1924-25 Tons.
Exports	2,909,624	.. 3,203,592	.. 3,760,186
Stocks	429,588	.. 432,123	.. 822,799
	3,339,212	3,635,715	4,582,985
Local Consumption	88,000	.. 85,000	.. 97,000
Receipts at Ports to August 31st	3,427,212	3,720,715	4,679,985

Havana, August 31st, 1925 J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR NINE MONTHS ENDING SEPTEMBER 30TH, 1923, 1924, AND 1925.

IMPORTS.

	1923. Tons.	1924. Tons.	1925 Tons.
Refined......	279,088 ..	393,685 ..	533,285
Raw	935,457 ..	943,701 ..	1,002,353
Molasses ..	100,573 .	139,431 ..	130,853
	1,315,118	1,476,817	1,666,491

EXPORTS (Foreign).

	1923. Tons	1924. Tons.	1925 Tons.
Refined...... ..	6,367 ..	4,657 ..	1,753
Raw..	13,896 ..	7,926 ..	559
Molasses	2,456 ..	2,581 ..	383
	22,719	15,164	

HOME CONSUMPTION.

	1923. Tons.		1924. Tons.		1925 Tons.
Refined	292,481	..	396,442	..	533,309
Refined (in Bond) in the United Kingdom	708,426	..	699,523	..	654,005
Raw	119,082		101,499	..	75,828
Total of Sugar	1,119,989		1,197,464		1,263,142
Molasses..	7,169	..	5,384		6,078
Molasses, manufactured (in Bond) in United Kingdom	39,449	..	44,291	.	42,345
	1,166,607		1,247,139		1,311,565

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT SEPTEMBER 30TH, 1925.

	1925. Tons.		1923. Tons.		1924. Tons.
Refined in Bond	48,450	..	38,950	..	45,750
Foreign Refined	17,800	..	12,800	..	31,000
„ Unrefined..	183,600	..	91,350	..	209,800
	249,850		143,100		286,550

United Kingdom Monthly Sugar Report.

Our last report was dated the 9th September, 1925.

The easier tone prevailing last month has continued only in a more accentuated fashion, and prices are about 2s. per cwt. lower for all descriptions.

The London Terminal Market has been flat and easier. While some heavy buying has been taking place these orders have been readily filled by Continental countries who have been using this market as a hedge for their sugar. A good many speculators have become disappointed and have cut their loss at almost any price. Altogether these circumstances have made a much more fluid market and a large business has been consummated. Only a few thousand tons were tendered on September which finally finished up at 13s. 8¼d. October sold down from 15s. 6d. to 13s. 3d., December from 15s. 6d. to 13s. 4½d., March from 15s. 6d. to 13s 9d., May from 15s. 10½d to 13s. 10½d., and August at 16s. 0¾d. to 14s. 3d. The latest prices are October 13s. 3¾d., December 13s. 6d., March 13s. 10½d., May 14s. 1½d., August 14s. 6d.

Trading in actual sugars has been very slow. The demand has continued poor owing to the obstinate policy adopted by the trade of buying strictly from hand to mouth. Russia has not been in the market and Germany has only bought spasmodically small parcels of ready sugar. Ready Granulated f.o b. has been scarce, but Dutch Granulated has been obtainable from 16s. down to 14s. 3d. Czecho Granulated for November and November/December sold from 15s. 3d. down to 13s 10½d., and for April/August from 15s. 9d, down to 14s. 6d. American Granulated was sold from 15s. 9d. down to 14s 6d. c i f. U.K., and at the beginning of this month a few thousand tons were sold back to New York at a parity of 14s. 9d. c.i f. Polish and Hungarian Crystals have been offering at 15s. to 13s. 3d. for November/December delivery but very little business has been transacted.

Spot sugars have not been plentiful. Dutch Granulated sold from 29s. 7½d. to 27s. 1½d. duty paid, whilst American Granulated was usually 6d per cwt. under this price. Low sugars on the spot have been very scarce and White Javas have fetched relatively high prices against good grocery.

The British Refiners have done a fair business at constantly declining prices. The following reductions took place:—14th September 3d, 16th September 3d., 21st September 3d., 23rd September 6d., 30th September 6d., 9th October 6d. The latest prices are No. 1 Cubes 32s. 3d., London Granulated 28s. 1½d.

A large business has been done with the U.K. and Continental Refiners. Cuban raws sold down from 11s 9d. to 10s. 6d. Mauritius Crystals sold at 16s. 1½d. to 15s. 7½d. Polish 88 per cent. Beet was offering at 10s. 3d. c.i f., and Preferential B.W.I. sold down to 14s. c.i.f.

In New York a fair business has been done in raws, and Cubans sold down to 2¼ cents. The Futures Market fell in sympathy with the easier raw and refined markets and to-day stands at 25 to 30 points lower than a month ago.

The Cuban crop has fulfilled expectations and is now reported to have finished with a crop estimated at 5,126,000 tons. The stocks at the ports are to-day 370,000 tons more than last year. The provisional estimates for next year are from 5,300,000 to 5,400,000 tons.

The weather on the Continent during the last three weeks has been ideal, and the general opinion seems to be gaining ground that the crops will turn out larger than they had first expected. This has been rather confirmed by the preliminary estimate by Mr. F. O. Licht of Magdeburg who gives the following figures:—

	Tons.		Tons.
Germany	1,680,000	Denmark	175,000
Czecho-Slovakia	1,600,000	Sweden	180,000
Austria	85,000	Poland	530,000
Hungary	220,000	Italy	200,000
France	780,000	Spain	225,000
Belgium	380,000	Russia.. ..	950,000
Holland	300,000	Other Countries	300,000
		Total	7,605,000

21, Mincing Lane,
London, E.C. 3.
October 9th, 1925.

Arthur B. Hodge,
Sugar Merchants and Brokers

THE
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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 323. NOVEMBER, 1925. Vol. XXVII.

Notes and Comments.

Mr. Alfred Wood on Beet Sugar Industrial Expansion.

Mr. ALFRED WOOD, Secretary of the British Sugar Beet Society, in a public speech he made last month gave an interesting outline of the programme of expansion of the sugar industry in this country, of which the following comprises the gist.

A wide programme of extension is envisaged for next year, and his Society notes with satisfaction that in most cases the proposed new factories are to be placed in new areas where hitherto through the absence of factories farmers could not enter seriously into the industry. The problem of overcrowding in existing beet areas has become acute, and the Society has asked the Ministry of Agriculture to receive a deputation which will suggest that the Government shall exercise supervision over the development of the industry, so as to ensure that each factory is able to draw beets from an economic radius, and so is given a fair chance of establishing itself upon a permanent basis during the currency of the subsidy.

The programme of the principal groups of manufacturers has been communicated to the Society. The Anglo-Scottish Group, of which LORD WEIR is Chairman, have acquired sites at Felstead (Essex), Poppleton (Yorks.), and Cupar (Fife), and building operations are to commence within a few weeks. The Anglo-Hungarian Group with which Messrs. Tate & Lyle, the leading refiners, are associated have decided to build a factory in Yorkshire in addition to their present factory at Bury St. Edmunds. The Anglo-Dutch Group, in which Mr. J. P. VAN ROSSUM is the leading spirit, have acquired a site at Yeovil and are acquiring sites in the neighbourhood of such well-known railway junctions as Didcot (Oxfordshire), Savernake (Wiltshire), Basingstoke (Hants), Pulborough (Sussex), and Bristol (Gloucestershire), for the erection of one or more factories according to the response by farmers to offers of beet contracts in the South and West of England. The old-established Lancashire refiners, The Sankey Sugar Co., Ltd., are to build a factory in conjunction with their refinery at Earlestown to serve the farming interests of Lancashire and Cheshire. Other groups, it is understood, contemplate factories in Surrey, Bedfordshire, Northants, Kent, Lincolnshire, and Suffolk. This brings into prominence the question whether the supply of raw material which can be looked for from farmers in the immediate future justifies so speedy a development in factory construction. This year's beet acreage, over 55,000 acres, is over 100 per cent. greater than last year. To bring the ten existing factories to their full capacity and thus reduce working costs to a minimum in the interests of both the factory and the grower, 100,000 acres are required for next year. To meet in addition the initial requirements of the proposed new factories, this acreage must be increased to at least 160,000 acres or three times the present acreage.

The National Farmers' Union is co-operating actively with the Society in an effect to extend the supply of the raw material, and is pressing on its members the desirability of testing, where that has not already been done, the suitability of sugar beet as a regular rotation crop. Owing to the subsidy the risks are not great, and it is desirable to secure a large number of farmers growing a relatively small acreage than having comparatively few embarking on the cultivation on an extensive scale.

But Mr. WOOD agrees that the farmers cannot be deemed to have been slow in embarking on this new industry. Some beet is being grown in practically every county of England this year and in many counties of Wales and Scotland. The farmers' principal difficulties are labour and accommodation. The industry can only develop at the rate at which these problems are satisfactorily solved. The dearth of rural cottages assumes a more acute form the more this labour question is examined. The Society invites local authorities to investigate the question in their own districts, and is ready to give all possible information that may be of assistance. The Ministry of Labour have given valuable assistance in the provision of additional labour for the singling and lifting of the present year's crop, and in this the factories, the National Farmers' Union, the Society, and other organizations have co-operated. The experience being gained will enable the Ministry to consider what further labour supply is required in the future. The Ministry have intimated that if the growers want to increase their acreage under sugar beet they need not have much anxiety about the labour supply provided that they will let the Employment Exchanges know well in advance the acreage of beet they have contracted for and the number of men they require. Provided that accommodation reasonable in the circumstances is available, the Employment Department have little doubt that they can supply men of the right type.

Rapid Progress of the Movement.

It is clear from Mr. WOOD's statement above given that very rapid progress is being made with the extension of the beet sugar industry in this country. The farmers are coming round to the idea of the value of growing sugar beets as a rotation crop with corn, or, where the soil is too light to make corn growing profitable, as a substitute for cereals. There is also the incentive of the subsidy on the sugar which has still two years to run at its full amount; and as it guarantees a remunerative price to the English farmer for his roots, that individual is the more disposed to overcome his innate conservatism to a change in the incidence of his crops.

Whether the farmers will do their part sufficiently well to enable not only the ten existing factories next year to operate to fairly full capacity, but will also allow the fifteen or more factories projected for the 1926-27 season to operate profitably is a moot point. It is more probable that for some years to come the complete organization of the cultivation and delivery of roots to the factories will need very expert supervision, and will not be accomplished in a hurry. As an instance of what can happen to a factory already past its elementary stage, it is reported that Kelham had to stop operations for some days last month because the steady supply of beets needed failed to materialise. But this is all incidental to the starting of so complicated an industry as the beet sugar one, and it is just here where the subsidy serves a good purpose by neutralising inevitable losses due to irregular supply of raw material, to defects in manufacture, and other like causes. The British Beet Sugar Society is acting wisely, however, in pressing for Governmental supervision over the siting of new projects, so as to prevent more than one factory being erected in one economic area of beet supply and so causing unnecessary competition. The success of the new industry promises to be of such material welfare to the agricultural interests in this country that nothing should be left undone to ensure that it has an unfettered trial free from all avoidable competition.

Supplementary to the information given above by Mr. WOOD, we may add that the Bedfordshire project which is intended to include also Buckinghamshire is to be at Linslade, near Leighton Buzzard, on Rothschild property. A private company, we gather, will finance this factory. Another private concern is to erect a factory at Bardney, Lincolnshire, the promoters being anglo-continental interests. The United Sugar Company's second factory is to be situated in the Selby district of Yorkshire. Finally, the Armstrong-Whitworth group are reported to be planning their first factory at Halesworth in Suffolk. The Kent project referred to by Mr. WOOD seems contingent on the obtaining of at least 5000 acres of roots from adjacent farmers; but as Kent is primarily a county of orchards and hop fields, there is an expression of doubt as to whether room can be found for the cultivation of beets as well. However, the country is being rapidly mapped out into beet areas to a degree that would have been thought unlikely of achievement a very few years ago; and the British consumer of sugar should next year from his 100,000 acres of beets have about 5½ lbs. of home-grown sugar per head of the population.

Indian Agriculture and the New Viceroy.

The recent announcement that the HON. E. F. L. WOOD, Minister of Agriculture in the present Government, has been appointed Viceroy of India in succession to LORD READING, who retires in April next, will have come as a surprise to many. As these appointments go, he is comparatively young (born in 1881), which is all to the good; is the only surviving son and heir to VISCOUNT HALIFAX, and is a great landed proprietor in this country. But it cannot be said that he is inexperienced, for he has in the past held the appointments of Under Secretary for the Colonies and President of the Board of Education: agriculture and education may be taken as the two main lines of development in our Indian Empire at the present moment. His extended visit during the winter of 1921-2 to the West Indies while at the Colonial Office will still be remembered; and the first-hand knowledge gained of a developed sugar industry will stand him in good stead in respect of the forward move now being taken in that staple in India.[1] When we consider the recent utterances of the Secretary of State for India regarding the necessity for the development of agriculture in that country along progressive lines, and the still more emphatic words of the present Viceroy at the end of his tenure of office, this appointment need not call for surprise. It may be remarked that such a forward agricultural policy has again and again been advocated in the local press, and especially by the *Times of India*, one of the leading progressive Journals, and it is to be presumed this will be in accord with Indian aspirations.

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[1] See *I.S.J.*, 1922, pp. 344-347.

The Indian Agricultural Department, founded on a liberal scale by that great Viceroy, LORD CURZON, comes of age this year, and its growth may be judged by the fact that, from a mere handful of superior officers in 1904, the official list of similar appointments, issued on January 1st of this year, shows an increase in cadre to somewhere near two hundred. And the actual development in agriculture, both as regards the knowledge of the subject and the concrete test of the increased yields obtained in those few crops which have been made the subject of special study, affords still more striking evidence of progress. An able summary of this progress is given in an article, holding the pride of place, in the handsome supplement to the *Times of India* (*Illustrated Weekly edition*) of August 2nd of this year, under the title "The Indian Empire—Financial, Industrial, Transportation and Trading Summary, 1925-6." In this article, written, we believe, by the Agricultural Adviser to the Government of India, it is pointed out officially that within the past two decades in one line of development, that of placing improved varieties at the disposal of the Indian cultivator, the area under selected strains has increased from a few thousands to five million acres, giving the ryot an increased profit of 50 million rupees (roughly £3,500,000), sufficient to cover the total cost of the Department five times over. But this is obviously only the start, and as these improved strains are rapidly spreading over the country, there is no reason why this figure should not be increased automatically forty times, for there are still 200 million acres sown every year with the inferior seed.

It is opportune to remark, however, that for still further advances and the extension of scientific study to the many crops at present almost untouched, much will depend on the maintenance in efficiency of the Agricultural Department. And we cannot look on this side of the question without a certain amount of misgiving, for its whole organization is in the melting pot. The Indianization of the Department has been decided on with this object in view and, for the benefit of the European officers desiring to leave the country before the normal tenure of their offices expires, they have been permitted to retire on a scheme of proportionate pension. Many have already availed themselves of this permission, and among them are a number of those investigators by whose knowledge and skill the above-mentioned results have been obtained; and others will follow as their terms expire, their places being filled by Indians where possible. Thus, in certain quarters a pessimistic view is indulged in, and as a fact there is bound to be a check, because of the depletion of the country of those who may be said to have mastered the intrinsic difficulties in conditions where every problem has to be approached along fresh lines, and the scientific training received in our great schools of agriculture has to be supplemented by long experience as to Indian environment and possibilities. The selection of the new Viceroy appears to us to have some bearing on this matter, and the amount of success in his guidance of the future development of the Agricultural Department may have a considerable bearing on the success or failure of his official connexion with the country.

A Sugar Estate Prospectus.

Early in the year a prospectus issued by a company calling itself Demerara Sugar Estates Limited, offering £40,000 of 8 per cent. debenture stock, attracted some attention in sugar circles owing to the studiously vague way in which it was drawn up and the difficulty to identify any of its promotors or its properties with the sugar industry in Demerara. *Truth* has lately investigated the matter[1] and has pronounced the issue as "a palpable ramp" got up by certain company promoters whom *Truth* has exposed on former occasions when operating under other names. The outstanding recommendation in the prospectus was a detailed report supposed to have been supplied by a Mr. HAROLD FLETCHER who was described as a retired planter and "the well-known sugar expert." But Mr. FLETCHER has now disowned the title thrust on him, and has admitted to *Truth* that he was a clerk in the employ of EBENEZER COX, a notorious figure who has been in the Bankruptcy Court, and who is alleged to have induced FLETCHER to put his name to the Report. The fictitious nature of this Report though not obvious to the man in the street could be detected almost at a glance by anyone connected with the sugar industry. It stated *inter alia* that the Otaheit (sic) should be planted, "as it produces four crops a year, while others only produce three and the crystallization is also more regular"; and that factories on the estates were equipped with a new method of juice extraction, viz., "modern diffusion with 25 per cent. dilution." The price of sugar was placed at £25 per ton, but taking only £20 per ton as the figure, and the output of the factories as 3000 tons, a net profit of £30,000 was confidently estimated. No details were vouchsafed as to the identity of the valuable property, nor of its previous career as a sugar producing business. Yet not only did the promoters (in *Truth's* opinion) get about £6000 response from the public, but they also managed to secure the names of a well-known nobleman and a firm of Edinburgh solicitors to act as Trustees for the Debenture holders.

An Expert View on British Optical Glass.

It has been long generally assumed that the best optical glass and optical instruments in the world come from Germany and Austria. This was undoubtedly true before the war, when the genius of Professor ABBE and his fellow-workers at Jena from the eighties of last century onwards produced new types of optical glass possessing high physical constants, which resulted in the world-wide recognition of the superiority of the distinctive products of Jena over similar optical instruments made in England and elsewhere, so that for the time being supremacy in such instruments practically passed to Germany.

But the war has changed all that, in the opinion of SIR HERBERT JACKSON, the Director of Research of the British Scientific Instrument Research Association. This expert recently wrote a letter to the *Times* in which he stated that a close study of British and foreign optical instruments extending over some years had led him to the conclusion that it is not possible at the present day to obtain anywhere optical glass and optical instruments better than, or, in many cases, as good as, those manufactured in Great Britain. The British manufacturers of such goods made such efforts during the war and since, as have enabled them to rival and, in many cases to surpass, the best foreign optical instruments in general.

In proof of this it was stated by another expert correspondent to that paper that the British Navy after rigorous tests as to the qualities of optical glass and optical instruments for naval purposes (for which, it stands to reason, the most accurate results are required) have decided that British productions are unsurpassed, and as a result these are being used in the Navy to the exclusion of others.

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[1] August 28th, 1925 issue.

Fifty Years Ago.

From the "Sugar Cane," November, 1875.

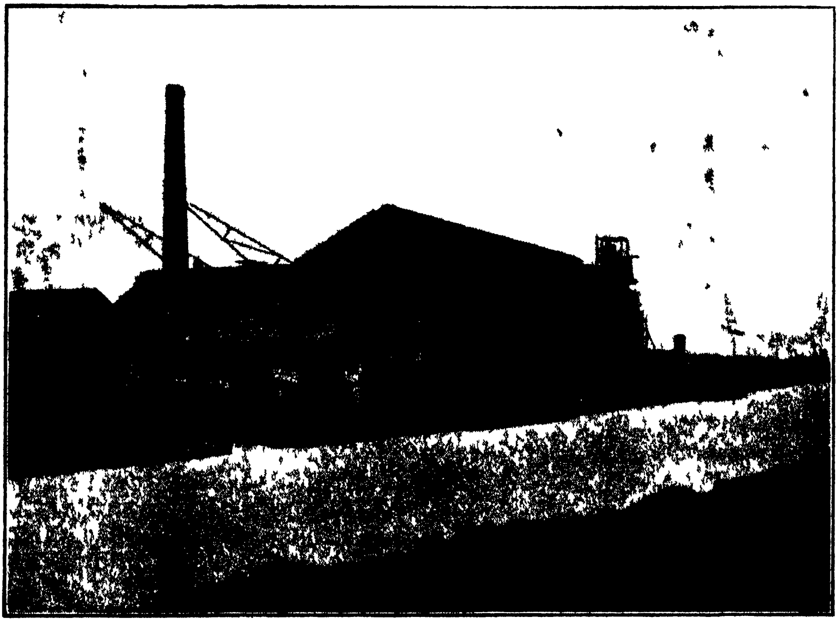
In our last number we dealt with an article which was entitled "The Distillation of Rum," and was written by R. H. **Burton**. It appears of interest to reproduce further extracts from it, these being examples of rule-of-thumb methods and of the beliefs, in the main conjectures, expressed fifty years ago of the causes contributing to the quality of the best flavoured spirit.

"Cane tops, that is, the plant and top without the leaf, cut up in a top cutter, if spread three or four inches deep in the mixing cistern, and allowed to remain there twenty-four hours after having had a puncheon of molasses mixed with it, makes an excellent ferment, imparts a fine flavour to the wash, and destroys any acidity that might be in the mixing cistern. I invariably enquire of all practical distillers if they think the weather affects the yield of the wash. They all agree that it does, more particularly a thunderstorm. On one occasion some years ago at Ponce, we had been distilling a number of vats, getting a good return; the vats had invariably taken about fifteen days to attenuate; they had had the same mixture, and had given the same number of gallons of spirit. A heavy thunderstorm occurred one afternoon, and the vats distilled the next day gave but little rum . . . . A large quantity of Jamaica rum is shipped to Germany, a mercantile house in Kingston, doing an extensive business in this line, employs tasters who travel about the island, pay a good price, and purchase that which they think adapted for that market. Distillers who wish to give this peculiar flavour to their rum use the following receipt:—Take 100 lbs. of yellow clay; this, with 5 lbs. of finely powdered brimstone, is thoroughly mixed in 10 gallons of low wines, to which are added 70 gallons of thick muddy skimmings, care being taken that the clay is thoroughly dissolved in the low lines, so that the mixture may be complete. To this add 4 lbs. of balm or fever grass (Spanish, *Lemoncilla*; French, *Citronelle*); the whole is placed in a puncheon to ferment, and after fermentation ceases it is fit for use; in fact the longer it is kept, the better the effect it produces. Two quarts are thrown into the low wine, and one quart into the high wine retort; when the rum first begins to run, it has a very unpleasant smell and taste, which, however, gradually disappears. This rum sells remarkably well, and distillers who produce it of the right flavour are generally rewarded by their employers . . . . . It was generally supposed that the use of sulphurous acid gas as a defecator for cane juice would have a prejudicial effect in the liquor-loft; so much was this a preconceived idea that a planter in St. Thomas-in-the-East told me he had some years past used sulphur in his boiling house, and the result had been most disastrous on his rum; another on the north coast experimented with sulphurous acid (or more probably with sulphuric acid), and his rum has been notoriously bad. Consequently, although I felt convinced "Stewart's Process" would more probably improve than deteriorate the rum crop, I was curious to see the result. Stewart's apparatus was worked by me at Rock River estate in the early part of March; the sugar was much superior to what had previously been made there, but having to return to Kingston I did not see any rum made until the 26th of March. I was surprised on nearing the still to find an unusually rich mellow, fruity aroma proceeding from the dunder, and on entering the liquor-loft a different odour from the usual one was perceptible . . . That sulphurous acid gas should produce good results on the juice of sugar canes can be easily understood; the gas checks acetous fermentation, and encourages the vinous type in such juice. Moreover, in good cane juice the gas acting as a defecator separates all the nitrogenous matter from the juice."

Ely Beet Sugar Factory.

On October 15th the new Ely beet sugar factory was formally declared open by the **Rt. Hon. Edward F. L. Wood**, Minister of Agriculture and Fisheries (and Viceroy-designate of India), in the presence of a distinguished gathering of guests interested in the new industry.

The Chairman of Directors, **Sir James Martin**, at the opening ceremony, gave some particulars regarding the factory. It is built on the banks of the River Ouse, one and a half miles from Ely Station and at the junction of a number of railway lines. The total area of the site is 66 acres. Four miles of railway sidings have been installed to deal with the beet traffic, and silos covering an area of 50,000 square feet have been constructed for the roots coming in by rail, road and by water. For the reception of the water-borne beet and for other purposes, a wharf has been constructed 650 feet in length with a depth of water sufficient to accommodate the largest barges which can be used on the river.



The factory has its own fleet of 50 barges, and claims that one of its services to the community is an organised attempt to restore the use of some of the waterways with which the country abounds. Thus there are four methods of getting the beets to the factory: rail, motor traction, horse traction, and carriage by water.

The area covered by the factory buildings is 2¼ acres. The main building is 360 feet long, by 82 feet wide, and is 52 feet high to the eaves. Behind it, but attached to it, are six separate buildings, consisting of:—(1) The pulp drying building with a floor area of 9500 square feet; (2) the power house building with a floor area of 4800 square feet; (3) the lime building with a floor area of 4800 square feet; (4) the boiler house with a floor area of 16,000 square feet; (5) the repair shop with a floor area of 9600 square feet; (6) the sugar store with a floor area of 16,000 square feet. The dried pulp store is a detached structure behind the pulp drying building and has a floor area of 13,500 square feet.

The capacity of the factory is 1200 tons, and to run a full campaign 120,000 tons of beet can be dealt with. There is the satisfactory number of 1179 growers, practically all of whom are within 20 miles of Ely. The output of sugar ready to be placed on the market when the full capacity of the factory is reached should be not less than 15,000 tons. The factory alone involves £400,000 of capital.

Ten Years of Sugar Refining.[1]

By L. A. WILLS,
American Sugar Refining Co., New York, N.Y.

Ten years ago, and even long before that, the process of refining raw cane sugar had already reached such a highly perfected state, that refined granulated sugar was at that time (as it is now) one of the most nearly chemically pure of all commodities. Nor were the principles involved in the refining process materially different from what they are to-day.

The bulk of the raw sugar received consisted, as it does now, of high grade centrifugals which were washed to a purity of approximately 99°. The use of animal blood for clarification had long since been abandoned in favour of phosphoric acid compounds. The best refiners attached the same importance to perfect mechanical filtration as we now know to be essential for the production of white granulated sugar. Bone-black was used in precisely the same manner as to-day, and was at least as effective in decolorizing and otherwise purifying the liquors. In fact, many refiners believe that the bone-black manufactured up until a few years ago was of better quality and less friable, by reason of a more plenteous supply of bones suitable for its manufacture, than is the present day product.

The spinning, washing, and drying of refined sugars have not changed materially in principle. In methods and equipment, however, much important progress has been made. There have been considerable improvements in labour-saving and other cost reducing devices.

RAW SUGAR WASHING.

As to the affination process, the self-discharging centrifugal basket used in several modern installations has fully proved its value. By its means the number of operators required at the washing station is materially reduced and with careful control the quality of the washed sugar is quite as good as ever.

Direct motor drive has made it possible to bring modern machines to full speed in a remarkably short time, and improved brakes have greatly shortened the braking period. One 48-inch machine of the type described will handle a quarter of a million pounds of raw sugar in 24 hours. It is all important for perfect and efficient operation so to train the operators that they perform each step with the regularity of a pendulum. The proper cycle of operation must first be worked out by intelligent study for each installation and for varying amounts of melt. When this is once established and each man is assigned to the proper number of machines, it is only necessary for each to charge, wash, and brake his machines in rotation at a measured pace, neither hurried nor sluggish. Only by such regularity can uniformly good washing be maintained.

Much has been done in the development of washing devices for centrifugals. Most of these deliver a measured quantity of water when a lever is turned by

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[illegible]nted before the Division of Sugar Chemistry at the 69th Meeting of the American Chemical Society, Baltimore, Md. (here slightly abridged), 1925.

hand and are refilled as the lever is reversed. Some distribute the water in a fanlike spray over the surface of the sugar, whereas others have an oscillating spray which directs a heavier stream of water progressively from top to bottom of the basket. Most centrifugals for both raw and refined sugar are now equipped with one or another of the many measuring devices and sprays.

One refinery has worked out an elaborate and ingenious system of automatic operation for its centrifugals by means of electrical control. In a battery of machines every operation except charging is electrically timed and operated. The writer saw in this plant one machine experimentally equipped which was even charged automatically, so that practically the only labour required for a battery of these was for supervision and maintenance.

LIQUOR FILTRATION.

Leaf filters began to replace the old bag-filters in 1914. Infusorial earth as a filter-aid was substituted for compounds of phosphoric acid wherever leaf-filters were installed. The latter are operated under high pressure, and phosphate of lime does not form a sufficiently porous cake under these conditions. On account of the cost of infusorial earth, which largely balances the savings in labour and filter-cloth, both large items for the old bag-filters, the economy of leaf filters has been questioned by some refiners.

In fact, so great has been the conservatism with respect to leaf-filters, especially for the filtration of affination syrup, that not only have many existing bag installations been allowed to stand, but a new refinery has recently been equipped with bag-filters. In the writer's opinion, however, there is no doubt of sufficient net saving in the combined items of labour, cloth, and filter-aid, to render an installation of leaf-filters, properly operated, a profitable investment. Furthermore, the cleanliness attending the operation of leaf-filters, and the rapidity with which the liquors pass through the process, both factors reducing the liability of sucrose losses through inversion, are features not to be overlooked.

Devices for sluicing the leaf-filters automatically have decreased the labour required at the filter station in several refineries. Rotary suction filters with continuous, automatic removal of the cake have replaced in some plants the usual types of filter-presses for the filtration of sluicings from leaf-filters.

An improved form of infusorial earth (prepared by a process in which calcination is understood to play a part) has been placed on the market within the last two years. This material at first gave a greatly increased liquor flow, but left something to be desired in clarity of filtrate. It has been the effort of the manufacturers so to modify the prepared earth as to give perfect filtration without sacrificing rate of flow, and the product now being turned out seems to give promise in that direction.

Regeneration of infusorial earth has been discussed ever since the material came into general use in connexion with leaf type filters. Many laboratory and some plant scale experiments showed that the earth could be efficiently revivified by burning, but several years elapsed before regeneration was put into actual practice. One refinery is now burning earth in the form of cake from suction filters in rotary kilns ; another has demonstrated the effectiveness of a stationary kiln, of the type used for burning lime, for calcining earth recovered as filter-press cake. In both cases the earth must be reduced to a finely divided state, for which purpose wet grinding is preferred.

About three years ago the use of paper pulp as a filter-aid was proposed. It was first tried in leaf-filters of the rotary type, which has since proved to be the only type applicable to this form of filtration. Several attempts were made to adapt the stationary leaf-filters to pulp filtration; but, so far as the author knows, the project has been abandoned. The pulp filter cake is extremely porous, is bulky, and must be quite evenly coated on the cloth. This is difficult to accomplish in any but the rotary type of filter. Removal of the cake is also accomplished more easily with the latter type. The used pulp is regenerated by merely washing out the impurities with hot water, for which purpose a form of washer common to the paper manufacturing industry is employed. A large quantity of water is required, but since waste water from the washing of char filters can be used the expense is small.

Paper pulp is furnished by the manufacturers in the form of thick sheets. Soda pulp, or a mixture of same with ground wood, is generally used, though it is said that old newspapers work equally well. New pulp is fed to the beater, a device also known to the paper industry, where it is beaten to a thick cream with sufficient water. The make-up of new pulp required is said to be surprisingly small, since mechanical loss through the washing screens is not great and the quality of the pulp does not appear to suffer after repeated use. Pulp filtration is characterized by a high rate of flow.

There still exists, however, a difference of opinion as to whether sufficiently clear liquors can be obtained at all times in refinery practice. It was early found that double or triple filtration through a heavy coating of pulp is necessary, and that the pulp must be augmented with a small proportion of some coagulant, such as phosphoric acid. This decreases the rate of flow, which remains, however, still relatively great.

In the case of filtration with infusorial earth, if a trace of the filter-aid passes into the filtered liquor, because of broken cloths or otherwise, it is caught in the char filters. In pulp filtration, on the other hand, if the filtrate is ever so slightly contaminated, it is sure to appear hazy after char filtration, and the fine suspended or colloidal matter persists and becomes more concentrated in the granulated syrups, to the detriment of the refined product. It is therefore essential in pulp filtration to obtain highly brilliant filtrates, and apparently all refiners who have tried it have not met with the same degree of success in the accomplishment.

BONE-CHAR FILTRATION.

Bone-black filtration presents little that is new. The continuous system of filtration has almost entirely replaced the old battery method, however, in line with the tendency of the times to cut down to the absolute minimum the amount of material carried in process. Oil firing of the kilns has become more widely used. A retort made in two sections is expected to cut renewal costs, since either top or bottom section can be replaced, separately, and the scrapping of the entire retort thus avoided.

EVAPORATION.

In the pan house a notable innovation has been the installation of multiple-effect evaporators for concentrating liquors previous to entering the pans. Sugar boilers have been able to accommodate themselves to handling pan liquors at 68° Brix, so that if the liquor runs from the bone-black filters at 55° Brix it is possible to accomplish about one-half the total evaporation in multiple-effect. and largely with exhaust steam. The saving effected is, of course, very great.

Another medium for the utilization of exhaust steam for evaporation is the calandria pan. Widely used in the raw cane sugar factories of Cuba, it has been adopted in some of our modern refineries.

Refined Sugar Centrifugals.

Improvements in centrifugal machines have been discussed in connexion with raw sugar washing. Although it has not been possible to apply the self-discharging principle to the machines used for the refined sugar massecuites, direct motor drive and various mechanical improvements have greatly increased their efficiency and eliminated labour. Separation of wash syrups from greens is now pretty generally applied to the lower granulated and remelt syrups.

Drying and Screening.

Methods of drying and screening sugar have remained practically unchanged during the last decade, except for the introduction to a very limited extent of air drying for the coarse-grained sugars to improve their brilliance. This has been accomplished by spreading sugar from the centrifugals in a thin layer on a slow moving belt, or, as in one case that has come to the writer's notice, by leading a current of warm, dry air through the housings of the screens used for sizing, At least in the former method it is essential to heat the sugar first by introducing steam into the centrifugal basket.

Packing and other Handling.

The packaging of sugar has received a liberal share of attention and some wonderfully ingenious devices have been perfected in this field of endeavour. Automatic feeders for the carton-filling machines, container-sealing machines, bag-filling equipment, and a variety of ingenious arrangements for filling cartons of soft sugar and for the tight packing of tablets and cubes are but a few of the many interesting improvements.

Methods of conveying, elevating, pumping, trucking, and otherwise handling the enormous quantity of material that daily passes through a modern refinery have kept pace with the engineering progress of the times, as have also the means of generating the prodigious quantities of steam and electric power required.

Progress in the Laboratory.

Last but not least, our chemical laboratories, guardians of the refining process and insurers of quality in the product, have kept in the vanguard of progress. Control of the refining process is being assisted by modern methods of hydrogen-ion determination and by systematic colour readings according to one or another method for expressing colour as a numerical value. Screen analysis has been placed on a scientific basis. Apparatus has been devised for comparing the filtrability of raw sugars and the efficiency of different filter-aids, so that these variables can now be expressed in figures. Routine purity determinations have been shortened by improved methods and equipment.

The sugar refining industry is, by the very nature of the vast scale of its operations, a conservative industry. A change in method usually means a change in equipment; and since most of the equipment is large and costly, a considerable outlay of money is generally involved. The foregoing summary of a decade's progress, however, will indicate that the industry's technical progress is steady and material.

The Fulton Ironworks Company have in hand two of the largest cane milling plants yet built, each being capable of grinding more than 4000 tons of cane in 24 hours at rated capacity. One is for the Central Santa Marta, owned by General Menocal (the ex-president of Cuba), and the other will be installed in the Central Cuba, owned by Col. Tarafa (president of the North Railroad of Cuba). Both consist of 36 in. × 84 in. triple crushers and six mills, and both will be electrically driven.

Natal.

The Third Congress, and Animal Transport.

The Report of the Proceedings of the Third Annual Congress of the members of the South African Sugar Association, which has recently come to hand, presents a very interesting comment on the development which is taking place in the Natal sugar industry. The meeting was confined to three days and, although its programme was seriously interfered with by the weather, this was evidently very carefully prepared, and a great deal of useful work was crowded into the short period allowed. A strong note was struck by one of the chairmen on the need for closer co-operation between the various members of the Association, the planters and the millers, the millers and the buyers; in fact, the necessity for all sections to combine with one guiding principle, namely, the placing of the industry on a permanently higher level. And this remark may have originated in the fact that the meeting was almost wholly devoted to the plantation side, presumably from lack of papers read by the more technical section. But there is much to be said for such division of labour: a meeting embracing all aspects of any subject inevitably involves a lot of "dead matter" to everybody attending; and sectional meetings of those responsible for producing the raw material, and of those fitting this raw material for the market and, possibly, the purely trade aspects, would save a great deal of valuable time; and should not at all interfere with the general idea of whole-hearted co-operation. The condition of the Natal sugar industry is ripe for such a division of labour; for, if we mistake not, the plantation side is at present very much behind that of the factory; while the general economics of the industry must and will receive more and more attention, now that the time is approaching for the final product to have to compete to an increasing extent with sugar produced in more favoured portions of the world's cane sugar belt.

In these days, large scale production is the key to success in any industry. Natal has special difficulties as a sugar producer, but there is not a country in the world which has not its own drawbacks; and the acid test for any place desiring to cater for the world's markets is the success with which it overcomes its own inherent disadvantages. This point of view should be kept prominently before the Natal sugar industry. What could be more hampering than the enforced rotation of "swamp" paddy and the sugar cane plant in Java? So also the labour difficulty, deforestation and consequent irrigation needs in Hawaii; the parochial nature of the industry in the smaller West Indian Islands; the low lying land and absence of labour in Demerara; the extremely short growing season and lack of humus in Louisiana, with its frosts in winter; the similar short season in India with its terrible dry heat, its swamping rains in summer, and its cold winter in the north; the restriction in land in Peru; and the uncertainty of the climate in Queensland. Natal has its drawbacks too, but escapes those mentioned; it is encouraging to note that those best qualified to judge look to the future with a considerable amount of optimism; and the Association, which is firmly entrenching itself, is tackling the various defects in a methodical and hopeful spirit. It is to be noted in passing that the two great sugar producers, Java and Hawaii, are outstanding examples of thorough-going co-operation in all branches of the industry; not a word of disunion is heard among the various sections, and great scientific and practical departments are liberally financed and entirely controlled by the industry itself. This may be justifiably regarded as the main reason for their phenomenal success. Natal may well count its mercies, for none of the great sacrifices involved in these two countries is likely to be needed for the development of its sugar industry in the future; and it is quite possible that the disappointment of the planters at receiving less financial assistance from the Government than may have been hoped for may ultimately prove but another blessing—in disguise.

The Congress appears to have concentrated its attention, as already noted, almost entirely upon the plantation side, and most of its members appear in consequence to have been planters. It has attempted to give its deliberations a more out-of-door character—unfortunately sadly interfered with by the unusually heavy rains—and this is as it should be, in that the new experiment station may be regarded as a fact, and there are now plots of cane elsewhere which most planters would be glad to go over under the guidance of those responsible for them. The three days were accordingly spent in widely different parts of the sugar cane tract. This appears to be a good move, being on a par with the practice of supplementing any course of lectures by practical work, wherever this is possible, in the study of any scientific subject. And of necessity only certain of the various lines of investigation were dealt with at all thoroughly; while abundant opportunity was offered for any planter to obtain information on special points by the admirable system of question and answer, coupled with free discussion, which was introduced. Naturally, the brunt of the work was borne by the small band of scientific officers, but papers by experienced planters were also given, and it is to be hoped that this form of co-operation will be further developed in the future. The planter inevitably approaches his subject from a more practical point of view.

Of course, streak disease received some attention, but it was in no sense allowed to dominate. A short and concise statement was made by H. H. STOREY as to the progress of his work and the position at the time of the meeting; and this was supplemented by a thoughtful paper by C. J. RAPSON on its control. Cane varieties suited to Natal conditions were discussed by H. H. DODDS, the Director of the Experiment Station; and a short résumé was prepared by VAN DER MERWE of the chief insect pests in the fields. Authoritative notes were given on cane loaders and harvesting machines; and papers were read on the possibility of employing white labour, and on native contracts, with designs added for hygienic and cheap dwellings on the estates. But more attention was focussed on the purchase of fertilizers (E. O. WILLIAMS) and the best methods of application (Mr. BLEWETT); the principles involved in green manuring (C. EDELMANN), and its application to sugar cane in Natal (H. H. DODDS); farm surveying (T. A. WARNER); irrigation (C. A. RITCHIE); and animal transport on sugar estates (V. C. SCHWIKKARD).

Animal transport on Natal sugar estates.—This last paper is perhaps of more general interest than the others, and a number of facts are brought out which appear to be worth recording. Mule and ox are exhaustively compared from the economic point of view, and notes are added on the local status of the horse and ass. The author commences with the statement that, although it is generally conceded that labour is the largest individual item in the production costs of sugar, that of draught animals is not far behind it. He also remarks that "Africa is practically the only country to-day which has retained the ox as its main source of draught labour. In the majority of other countries of intensive agricultural development, the ox has been supplanted by either the horse or mule." This will sound rather strange in the ears of anyone who has worked in the tropics of the east or, indeed, in Egypt; for the ox is almost universal in these parts and, if an alternative is sought, it is found in the somewhat similar buffalo: the horse is not generally suited to draught conditions in the tropics.

As a result of a recent investigation into the production of maize, it has been shown that, in this crop, ox labour is responsible for 17·7 per cent. or over one sixth of the gross cost. The author assumes that this figure will probably be increased in the cane fields, but there are at present no data available. Of the animals employed on sugar estates the "trek ox" is present to the extent of 85 per cent., as compared with 10 per cent. for the mule. Immunization of horses against "sickness" has not yet advanced far enough for their employment. Because of east coast fever, and the consequent restriction of cattle movement, donkeys are used in some places; but these have proved of very little use as draught animals. Once acclimatized, donkeys are immune, but they are considerably slower than cattle, require the same number of attendants, grain rations and housing, and great patience on the part of their drivers.

The coastal sugar cane tract is the most intensively cultivated part of Union of South Africa, and Natal is more so than Zululand, but its broken character and hilly nature do not lend themselves to the extensive use of tractors. The grazing problem is thus serious, and tends to be increasingly so. But the price of land is not the only factor in this matter; and its productivity must also be taken into account. Naturally, only the worst pieces are relegated to grazing, and the best taken for sugar cane growing. Again, relying on the maize investigation, the cost of each ox per day is taken as 4¾d.: but the price of sugar cane land is considerably higher than that used for maize, and the author therefore concludes that maintenance of oxen on cane land will probably be higher: at any rate the figure given will be distinctly conservative. From data obtained from experienced planters as well as his own personal observations, SCHWIKKARD considers that the cost of maintenance of a small mule per day will not be more than 1s. The relative initial cost of oxen and small mules is not given. The cost of the native labour employed is taken at 2s. 4d. per day.

Certain facts have been collected concerning the working efficiency of the two animals. (1) A yoke of 12 oxen about equals a team of eight small mules in pulling force for the plough: (2) The oxen will do ¾ acre in a day, while the mules will get over 1¼ acres: (3) A span of oxen needs three attendants, plougher, driver and leader; while the mules answer to the reins, and therefore will work without the leader, and only two attendants are required. Therefore, to plough an acre by oxen will cost about 15s. 8d., while by small mules it can be done for 9s. 8d. Besides this, the mules do the work quicker; and this is a matter of great economic importance in a country of irregular and uncertain rainfall. There are other points, however, to be considered in comparing the two animals, which cannot be put so readily into figures. Oxen cannot be continually worked on grazing only, and to purchase fodder for them is not considered an economic proposition. No figures are available, but 60 per cent. is regarded as a fair proportion of working days in the year: mules, on the other hand, work almost continuously if properly cared for, and the working days in the year will come to somewhere around 90 per cent. The most intensive labour is required in the spring, when however the oxen are less fit, because of the general scarcity or poverty of grazing. In extreme heat, also, the cattle easily become distressed; and if not outspanned immediately run the risk of suddenly dying. It is thus often the practice to work them only in the cooler part of the day or even, on fine nights, right through, and let them rest in the day time. As regards working in the rain, any animal is liable to be chafed, and this means an enforced resting period.

Feeding and care.—In any year more cattle die from poverty than any other cause: overwork contributes, but the main factor is, in reality, a slow starvation. On sugar estates there is little land available for grazing, because of its cost; and such as is allocated for the purpose will as stated be the poorer land of the estate. Such land under oxen soon deteriorates, for, like all grazing animals, they select the more palatable grasses; these happen to be also the more nutritious and, unfortunately, specially shallow-rooted, so that they are often torn out of the ground: and ultimately nothing is left but the coarse, deep-rooting, unpalatable "wire grass," of low nutritive value except in its young stages. In winter only cane tops are available, but these are frequently burnt; and little provision is made for feeding the cattle at night. When tops are used, they should be chaffed and fed in the manger: if thrown down on the litter most of them are wasted. The addition of molasses, which is easily obtained from the mills, will be of great benefit; but this carbohydrate food should be balanced by some proteid, such as oil cake or cotton seed meal.

As to mules, few animals respond so readily to treatment. If cane tops and nutritious grasses are available purchase of fodder is unnecessary, but these should be cut fresh every day, the former being chaffed and mixed with molasses in the manger, and the latter placed in a convenient rack above it. Three pounds of molasses and one quarter of proteid food, given in equal quantities morning and evening, will be a suitable ration for animals in hard work, and will keep the mules fit and in condition: curiously, when allowed to rest, they often lose condition. It is hence advisable to have an area of cane set apart for green food for the animals, which can be cut day by day: this area need not be large, because of the abundant tops available during harvest time. Mules require stabling in open houses, only protected towards the prevailing wind and rain: the floors should be bedded with litter and trash every night, and this should be aired during the day. But it soon spoils and is then heaped to be added later to the manure.

Type of animal.—Although, then, it is recognized that mules are better for draught purposes than cattle, it will be some time before they can replace them. Experience shows that oxen with any pretensions to breeding, except Africanda or Zulu, are quite unfit for draught purposes; but these are hardy, maintain their fitness and are less affected by heat. Such cattle are only obtainable in limited quantities, but it is well worth paying £1 to £1 10s. more for them. If coming from other places, it is advisable to import them only from the gallsick or red water areas of north Natal. The best time to introduce them to the coast is from June to August, because of the prevalence of these diseases at other times: a further precaution is to work them soon after their arrival. Imported cattle require one year to acclimatize, and during this period should be allowed frequent resting periods.

The mules at present in the coastal region are entirely of the small type, up to 14½ hands, and only these have been referred to in the preceding notes. But if these animals are extensively employed, it will be worth while to study the respective economic value of the small and large types (15½ hands and upwards). Although of course costing more to purchase and slightly more for maintenance, there would appear to be little doubt that the larger animals will prove more economical, as six of them equal ten of the smaller, and their work is of a higher quality. But the demand for the big mules is greater than the supply, and the present prices are prohibitive for the cane plantations. If, however, obtainable for £25 to £30, they are to be recommended in preference to the smaller animals now in use.

There is at present no mule breeding in the coastal tract, so that they have to be obtained from other parts of the Union: like oxen, they must be given one year to acclimatize, with a corresponding diminution of utility during that period. In buying 5 to 6-year olds, 12 years of work may be expected from them. Unbroken mules are not recommended, unless there is local experience in this and the time to break them in: a well trained mule is worth £2 to £3 more than one unbroken to work. Because of horse sickness, all mules must be immunized: this is more successful if done in the district, and when the animals are kept in an open shed as described: it will cost 10s. per head if done by the Government Veterinary Department, and the animals recover in about three weeks from the treatment. Naturally, it is safest to import after the horse sickness season is over, because of the danger of contracting the disease on the way or before the treatment has been effected. July and August are the best months for introducing the mules. One point more: it is of the greatest importance to select a good driver and make as few changes as possible, as both oxen and mules only give their best work with the men who constantly drive them.

C. A. B.

Trinidad Cane Farming and Sugar Crop Returns, 1925.

Below are the annual figures of the Trinidad 1925 sugar crop, as compiled by Messrs. Edgar Tripp & Co. The crop, as will be seen, has been the largest since 1917, and with the exception of that year, when the output was 1263 tons more than in 1925, the latest crop has surpassed all previous ones during the past 27 years. Prices unfortunately have ruled on the low side; but on the other hand, this crop has had the benefit of Imperial Preference as regards exports to the United Kingdom.

ESTATE.	Total Sugar made. Tons	Tons of Sugar made from Estate Cane	Tons of Estate Cane Ground	Tons of Cane Purchased	Amount paid for Canes $	No of Farmers	
						East Indian	West Indian.
Brechin Castle	4,160	3,022	31,155	12,136	37,383	586	405
Bronte	4,111	2,045	21,116	22,706	68,117	662	176
Caroni	* 6,060	3,620	42,855	29,427	90,795	911	438
Craignish	925	277	3,216	7,563	24,770	* 585	* 391
Esperansa	3,133	1,879	17,849	15,402	46,206	488	293
Forres Park	1,937	1,113	12,808	10,066	30,323	535	218
Hindustan	916	268	3,143	7,584	25,482	180	518
Imperial College	246	—	‡ 2,431	2,606	* 13,032	16	11
Reform	† 775	216	3,259	8,458	28,394	362	123
Tacarigua Factory	5,520	2,861	30,605	28,446	95,451	1,119	1,175
Usine Ste. Madeleine	23,520	14,850	141,825	83,045	239,159	3,455	2,188
Waterloo	10,175	5,935	59,353	46,436	139,308	1,119	730
Woodford Lodge	† 8,150	2,907	25,490	53,739	172,674	1,400	1,300
	69,628	38,993	395,105	327,614	1,011,094	11,508	7,966
Return for 1924	52,045	30,862	324,361	237,298	1,130,346	9,952	7,116
„ 1923	41,619	24,251	253,211	186,445	665,378	9,670	6,830
„ 1922	59,948	29,599	340,358	355,364	813,036	12,605	8,745
„ 1921	54,933	24,207	286,974	389,399	1,773,227	15,046	11,379
„ 1920	58,416	28,953	319,421	344,226	2,924,404	14,536	10,824
„ 1919	47,850	24,656	275,451	270,324	1,210,155	12,370	8,568
„ 1918	45,256	22,544	252,783	266,144	812,247	12,158	8,244
„ 1917	70,891	36,102	378,999	384,650	1,093,770	12,055	8,984
„ 1616	64,231	35,653	426,106	363,775	1,008,665	14,014	8,212

* Estimated. † This is approximate and includes sugars in process.
‡ Canes grown at Government farm
N.B.—No returns available from "Golden Grove" Estate.

Froghopper Pest of Sugar Cane in Trinidad.

From the discussions which have taken place in the Agricultural Society of Trinidad, and from the remarks appearing in the newspapers of the Colony, it is evident that the sugar planters of the island are at the present time confronted with a grave outbreak of the froghopper pest, which threatens seriously to curtail the coming sugar crop. This is the more to be regretted seeing that there has recently been a disposition to cut down some of the less productive cocoa trees and to devote the land to sugar growing; a step which is indicative of the increased interest which is being manifested in sugar cultivation and of the desire to increase the sugar output of the Colony.

The froghopper (*Tomaspis saccharina*), has for a number of years been a serious menace to the sugar canes of Trinidad and has been a matter of grave concern to the sugar planters who have been unable to obtain any direct and effective remedy for the pest. It has been the subject of many investigations extending over the past sixty years, but, while these investigations have thrown much light on the nature of the trouble, much still remains obscure and planters appear to be unable to ward off attacks. The investigations have shown that much depends on the nature of the season; extreme dryness during the dry season and extreme wetness during the wet season appear to increase the prospects of an attack. It is generally felt that the attacks are also influenced by the condition of the soil and it has been suggested that canes growing on acid soils are more liable to attack, hence the application of lime to the soil has frequently been recommended.

Evidently environmental conditions, including the nature and condition of the soil and the character of the season, particularly as regards its dryness or humidity at critical periods, largely influence attacks; and it is felt that much more is required to be known about these and their interaction before satisfactory methods of control are likely to be forthcoming, while much more information is required concerning the natural enemies of the insect, of which several are known.

Heavy infestations during the years 1906, 1907 and 1908 drew attention to the capacity for mischief possessed by this pest, and the officers of the Agricultural Department were actively engaged in making observations concerning its habits, at the same time endeavouring to find remedies or ameliorants. Stimulated by their observations and advice, the managers of several plantations endeavoured to put into practice many of the recommendations put forward, at the same time giving attention to the better cultivation of the soil and the reduction in the quantity of ratoon canes kept on the estates.

At this period very remarkable activity was manifested on several estates in connexion with the distribution over the cane fields of the spores of the Green Muscardine fungus, (*Metarrhizium anisopliae.* Sorokin). This fungus was cultivated in large quantities on cooked rice and, when the spore-bearing stage was reached, the dry material was distributed freely over the field where attack was feared. Various methods of application were adopted: in some instances the mixture of rice and fungus with its spores was distributed by means of some form of mechanical blower, in others it was dusted on canes by hand, while in yet other instances captured froghoppers were dusted, or brought into contact with the spores of the fungus and then liberated in places where attacks were beginning or were feared. The Green Muscardine fungus attacks the living froghoppers, the germinating spores sending out hyphae which penetrate the body of the insect, killing it; subsequently the fungus growing in the body of the froghopper develops large quantities of spores on the exterior of the insect, thus spreading the infection and reducing the number of insects by causing further mortality amongst them.

This fungus is normally present where froghoppers are prevalent and doubtless constitutes one of the natural means by which the pest is kept in check: it was hoped that by artificially increasing the quantity of the fungus present it would be possible to hasten the extermination of the pest. Many scientific workers are inclined to question whether artificial interference is calculated to do much in extending the spread of a naturally occurring parasitic fungus. However that may be, the practice of preparing and using the fungus in the manner described has not been actively followed of late.

Knowing that the froghopper is an ever present menace and recognizing that the circumstances influencing its development and spread are imperfectly understood, and feeling that until there is fuller knowledge on the subject little progress with regard to its extermination will be made, the sugar planters of Trinidad recently put forward the suggestion that a permanent Committee should be established under the auspices of the Government, charged with the duty of undertaking scientific investigations concerning the pest with a view to finding methods of control. The leaders of the movement wisely recognized that it would be necessary to carry out untrammelled investigations extending over a period of years and that it would be useless to expect useful results from work mainly and immediately directed towards finding remedies; they recommended, therefore, that provision should be made for properly directed scientific work relating to froghoppers by research workers definitely employed for this purpose, upon whom no other duties would be imposed and whose attention would not be diverted from the objects in view. To this end, they recommended the appointment of the Committee referred to, and suggested that a sum of £2500 a year for five years should be placed at its disposal. This sum, it was anticipated, would enable one or more skilled investigators to be employed on the work and that this, with the facilities available in the Colony, would permit of its being satisfactorily carried on.

The principal sugar growers of the Colony agreed to find one half of the required sum if the Government would provide the other moiety from public funds and appoint the Committee. To this the Government promptly responded by placing on the Estimates a sum of £1250 per annum for five years, on the understanding that the sugar planters would provide a similar sum.

It is unfortunate that through some unforeseen delay the sugar planters have not yet notified the Government that the money which they are prepared to raise is available, consequently the Committee has not yet been appointed and the contemplated investigations are in abeyance. Doubtless, the severity of the present attack will lead to action being very promptly taken and it is to be hoped that useful results will soon be attained.

It is curious that while froghoppers of several species are known to occur in other localities in the neighbourhood of Trinidad, they have, so far, not proved to be serious pests of sugar canes there; it is true that minor outbreaks have occurred, but they have not attained the disconcerting severity of those experienced in Trinidad. Evidently froghoppers are sensitive to environmental conditions and it is anticipated that a careful study of these may throw such light on the matter that it may be possible to devise methods of control which may be capable of ready and profitable application.

The whole subject was very carefully investigated some years ago by C. B. Williams, who began work in Trinidad early in 1916, and reported in 1921. When he left the Colony in that year, and his scientific researches were discontinued, such further work as could be done was carried on in a routine manner by officers of the Agricultural Department, whom it has not been possible to set aside entirely for this work on account of the numerous other demands on their time. It is in these circumstances that the sugar planters of the Colony desire that specific and long continued researches should be resumed.

Williams' report is an important one, for it puts on record all the information that could be gleaned at that period. It records observations on the nature of the insect and its natural enemies, many of which have been closely investigated. It also discusses the probable bearing of various environmental factors, including rainfall and general humidity, that of the character of the soil, and of the methods of planting, tilling, cultivating and manuring. Suggestions are made with reference to methods of control, all of which have been experimented with with various degrees of success: but with all the work done—and it is excellent and important—the impression remains that much further research is necessary before the problem can be solved; and it appears probable that several of the scientific advances recently made may now be brought to bear, and that increased knowledge of the nature of insect attacks, of the physiological reactions of the plant and of the soil, will enable the work to be successfully prosecuted.

The sugar planters of Trinidad have sufficient incentive to provide money for these investigations, for the attacks of the pest have resulted in serious losses in the past. Williams records that the losses experienced from 1907 to 1912 were estimated at about £55,000 a year and he puts the probable loss experienced in 1917-18 at something in the neighbourhood of £300,000. It is feared that the loss from the present attack may be very serious; it is impossible to estimate it with any degree of accuracy, but from the statement made by Mr. W. R. Nowell, the Assistant Director of Agriculture, at the meeting of the Trinidad Agricultural Society held on September 10th, there is apprehension that this present attack may prove as disastrous as any that have been experienced. It is obvious, as he pointed out, that nothing can now be done to save the canes that are being destroyed, for the damage is already done. Hope lies in the prosecution of fresh researches with a view to a proper understanding of the complex and difficult problem.

Weather conditions in South Africa this season have been ideal for harvesting, and the crop estimates have been increased to 216,534 tons. Some 6000 tons have already been exported to the United Kingdom, and it was expected that a further 15,000 tons would be exported before the end of October. Demand within the Union continues steady.[1]

Dr. E. Preissler, speaking at the recent 75th anniversary of the Society of German Sugar Manufacturers, at Magdeburg, in the course of his address remarked that war and post-war government regulations brought much grief to the sugar industry. Even to-day they suffer, though restrictions have been almost all removed. Germany once led beet sugar producing countries in production, but the annual crops of 1923-24, compared with 1913-14, show a decrease of 1,000,000 tons of raws and the cane sugar production of the world has practically superseded that of beet sugar. Of the 19,300,000 tons produced in the world in pre-war times, beet sugar supplied 47 per cent.; but of the 20,000,000 tons produced in 1923-24, beet sugar only held 30 per cent. These figures speak for themselves. It will take tremendous energy, Dr. Preissler concludes, to restore the production of beet sugar to its former figures.

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[1] *Standard Bank Monthly Review.*

The Weighing of Sugar Juice.

An Important Invention.

(Contributed.)

INTRODUCTION.

The weight of the raw juice is one of the most important data on which the control of the manufacture of sugar is based. The method of determining this quantity which is commonly in use in the majority of cane sugar countries may nowadays be considered obsolete. It consists of measuring the volume of the juice in tanks, recording its specific gravity and its temperature, and finally calculating the weight from these data.

The simplest and most rational method is, of course, to weigh the juice direct by means of juice scales; and the attention of engineers has for some time past been focussed on the construction of a reliable, automatic, and accurate apparatus for doing this. Indeed, as far back as 1906, the Sugar Syndicate of Java endeavoured to stimulate interest in this problem by a substantial prize for a suitable design; but those submitted within the time limit fell short of the requirements specified. At the present day few types of automatic juice scales are on the market, and of these still fewer have met with any degree of success. Quite recently, however, a satisfactory weighing apparatus has been invented. It has been declared by the Director of the Sugar Experiment Station in Java (Dr. PH. VAN HARREVELD) to be "the most accurate weighing machine which exists," and that where used in Java it has never failed to do its work perfectly. This is the Boulogne machine.

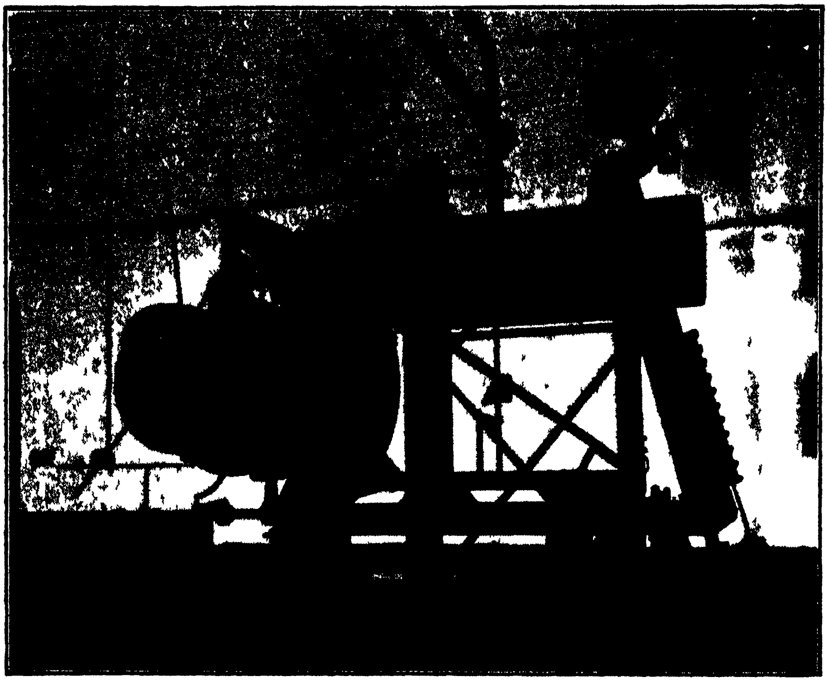

FIG. 1

The Weighing of Sugar Juice.

THE BOULOGNE SCALE.[1]

The great difficulty in the weighing of raw juice lies in the accumulation of adhesive dirt in the weighing receptacle, which consequently increases in weight and thereby causes inaccurate weighing. Juice scales of the usual automatic type therefore require frequent cleaning of the juice receptacle in order to preserve a certain degree of accuracy in the weighing. This inconvenience is removed and virtual accuracy is secured by adopting the method known as "tare weighing," on which the Boulogne Weighing Apparatus is based. Juice scales constructed on this principle operate as follows:—

After the pre-determined load of juice is discharged, a certain residue is deliberately left in the weighing receptacle. This residue is called the tare weight. Its weight plus that of the receptacle always remains constant.

It matters not what this residue (tare weight) consists of. At the commencement of work, with a clean tank, it will consist solely of juice; but, as dirt accumulates, this dirt displaces an equivalent weight of juice from the tare so that the tare weight is not in the least affected by the increment of extraneous matter. As the weight of the full juice tank is always constant, and the tare weight (however constituted) is also constant, it follows that the discharge, that is, the full weight less tare, is also constant. Therefore, despite the increase of dirt adhering to the receptacle, the apparatus continues to deliver the same weight of juice at each weighing.

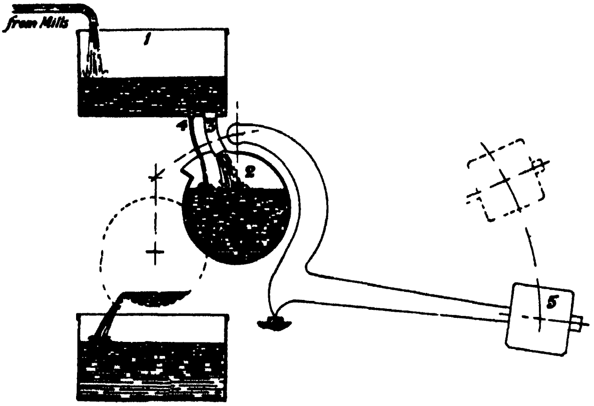

Fig. 2

Of course, the moment that the weight of the accumulated dirt exceeds the tare weight, the accuracy of the weighing becomes affected. But this condition never arises in practice, since, for obvious reasons, the juice scale must be cleaned at periodical intervals, say four or five days. Thus the weight of the tare is fixed sufficiently large in order to accommodate the maximum increment of dirt that may be expected to accumulate between two cleaning operations.

The Boulogne weighing apparatus operates entirely automatically, and without any electric control such as is sometimes met with in other automatic designs. The automatic operation of the different parts of the apparatus is simply derived from the weighing beam, which under the influence of the weight of the liquid to be weighed performs a tilting movement.

The operation may be briefly described as follows (see Fig. 2 in conjunction with Fig. 1):—Raw juice from the mills is pumped up into the receiving tank *1*, then runs into the weighing receptacle *2* through two valves, a large one *3* and a small one *4*. As is seen, the weighing receptacle is suspended from one end of a weighing beam, and is to a certain extent rotatable upon its horizontal axis. At the other end of the weighing beam a counterweight *5* is provided.

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[1] This apparatus has been lucidly described by W. F ALEWYN in *De Suikerindustrie*, passages from which paper have been included in the present article.

The juice flows through both valves of the receiving tank into the weighing receptacle. This gradually fills, and at a certain moment when a pre-determined weight of juice is approached the large valve is automatically closed by a trigger device. Juice then continues to trickle only through the small valve. Immediately the total weight of receptacle and contained juice overcomes the counterweight, the balance is disturbed. The small valve closes automatically and the beam from which the weighing receptacle is suspended tilts over into the discharge position.

Whilst descending the weighing receptacle turns slightly round its axis in order to allow the juice to discharge freely from the outlets. No sooner does the counterweight overcome the weight of the emptying receptacle than the weighing beam tilts back into its original filling position. A certain amount of juice including dirt will always remain in the tank and constitutes the so-called "tare." The above operation then begins anew.

It would hardly be in place here to describe the constructional details, but it may assist the reader to understand the apparatus better if the principle of the mechanical operation is here given, the figures used in the diagrams being simply by way of example. In the filling position (Fig. 3) the arm carrying the counterweight is horizontal and exerts a force of 80 × 500 lbs. = 40,000 lbs. The arm carrying the weighing receptacle is at an angle, and assuming its projection on the horizontal to be 20 in., we find that the weight of the receptacle plus that of the juice contained therein must be 2000 lbs. (20 × 2000 lbs. = 40,000 lbs.) to produce a balance. The position indicated in Fig. 3 occurs when the receptacle is completely filled. A slight excess of juice suffices to upset this balance and causes the scale to tilt into its discharge position as shown in Fig. 4.

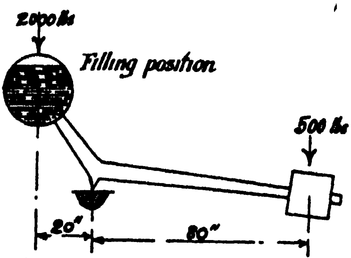


Fig. 3.

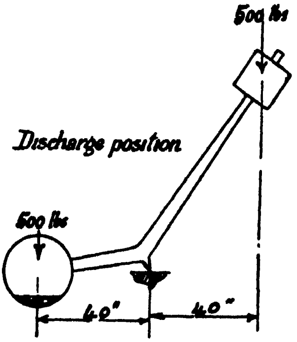


Fig. 4.

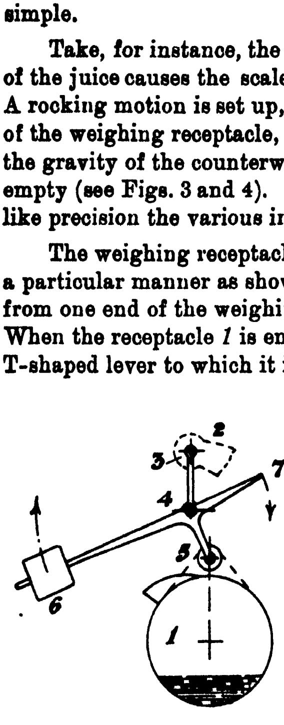
The arm carrying the counterweight is raised at an angle while that carrying the receptacle is horizontal, and the juice is now being discharged. At the moment the weighing receptacle is empty but for the tare, balance again occurs, the force on either side of the fulcrum being 40 × 500 lbs. = 20,000 lbs. The amount of juice discharged is therefore 2000 lbs. — 500 lbs. = 1500 lbs. No sooner a few more drops run out than the balance is again disturbed and the scale tilts back to its original position (Fig. 3) when the filling process begins anew.

If we take the weight of the weighing receptacle at, say, 300 lbs., then the tare will be 500 lbs. — 300 lbs. = 200 lbs. Though part of the 200 lbs. of juice may have been replaced by adhering dirt, no difference whatsoever is caused thereby in the weight (1500 lbs.) of juice which is discharged at each weighing.

The Boulogne scale comprises several ingenious devices which may at first sight appear somewhat intricate, but on closer examination are actually simple.

Take, for instance, the way in which the juice valves are operated. The flow of the juice causes the scale to operate automatically in the manner of a clock. A rocking motion is set up, the motion in one direction being caused by the filling of the weighing receptacle, while the motion in the opposite direction is caused by the gravity of the counterweight overcoming that of the weighing receptacle when empty (see Figs. 3 and 4). This rocking motion actuates consecutively with clock-like precision the various inlet and outlet mechanisms.

The weighing receptacle is accordingly suspended from the weighing beam in a particular manner as shown in Fig. 5. The weighing receptacle *1* is suspended from one end of the weighing beam *2* by a system of three fulcrums *3*, *4* and *5*. When the receptacle *1* is empty the effect of the counterpoise *6* is to depress the T-shaped lever to which it is attached, and thereby cause the opposite end *7* to lie in an elevated position. In this state the fulcrums *3*, *4* and *5* are considerably out of alignment. As juice runs into the weighing receptacle, its effect is gradually to raise the counterpoise *6* (as shown by the arrow), whilst the finger *7* at the opposite end is correspondingly depressed. The fulcrums *3*, *4* and *5*, accordingly, move towards alignment. At a certain point, when the receptacle is almost full, the depression of the finger *7* actuates a trigger which allows the large inlet valve (see Fig. 2, ref. 3) to shut off the main supply. Juice then continues to run into the weighing receptacle through the small valve (see Fig. 2, ref. 4) until the balance is disturbed and thereby causes the scale to tilt. A finger attached to the end of the weighing beam actuates another trigger whereby the small valve is now closed. The juice supply is thus completely shut off and the weighing receptacle descends to its discharge position.



(317) *Fig. 5.*

The Boulogne scale is further provided with a special oil buffer patented by the inventor, which controls the speed at which the weighing beam moves and at the same time prevents any shocks or jars to the mechanism of the scale. Various other ingenious means have been devised with a view to achieving extreme sensitiveness of the scale, but it would be out of place to describe them here. The number of weighings is recorded on an automatic counter.

The time occupied for filling the juice receptacle is regulated to correspond with the rate of crushing of the mills. At the factory Majong (Java) the apparatus is so adjusted as to allow 30 secs. to complete the filling after the main (large) valve is closed. The scale then tilts and discharges its load, and in 1¼ mins. the apparatus has returned to its filling position. The juice supply tank above the scale is therefore made sufficiently large to contain the amount of juice produced during 2 mins. of crushing.

SUMMARY.

Advantages of the Boulogne Patent[1] may be briefly summarized as follows:—

(1) It is based on the principle of tare-weighing; which is the only practical method for accurately weighing liquids which deposit adhesive dirt, such as cane juice. (2) It operates entirely automatically, by means of gravity, and does not depend on external control, such as by human or electrical agency. (3) It works without any shocks or jolts whatever, and therefore operates as regularly and smoothly as a tower clock with practically no wear and tear. (4) The mechanism does not come into contact with the juice, and consequently does not become corroded or clogged with dirt which would affect the accuracy of the scale. (5) It does not require cleaning for several days, the period between two cleanings depending on the weight of the tare which is fixed at will. (6) It achieves extraordinarily accurate weighing.

No other automatic juice scale has yet combined the above enumerated qualities. In support of this statement, Dr. PH. VAN HARREVELD'S testimonial already cited may be adduced.

It is being used in sugar factories for the purpose of weighing (1) maceration water; (2) mill juice; (3) concentrated juice; and (4) molasses.

At present, only three years after its patents have been granted, there are 24 Boulogne scales in use in Java. The machine is patented in all important sugar countries, and we understand that its manufacture outside Holland and Java is placed in the hands of The Sugar Machinery Mfg. Co., Ltd., of London.

The Cuban 1924-25 Sugar Crop.

The Final Figures of Output.

Messrs. GUMA & MEJER have just issued their final tabulation of the Cuban 1924-25 sugar crop, the summary by provinces being as below. The five largest outputs were from factories in Oriente and Camaguey provinces, and were as follows: Delicias, 116,156 tons; Morón, 100,838 tons; Manatí, 88,261 tons; Baraguá, 86,510 tons; and Cunagua, 85,860 tons (all of 2240 lbs.).

		SACKS *	
PROVINCES.	CENTRALS	Total.	Estimate
Pinar del Rio	10	1,399,241	1,215,000
Havana	17	3,021,434	2,575,000
Matanzas	28	4,359,144	3,930,000
Santa Clara	56	7,889,210	7,203,000
Camaguey	28	10,137,970	9,470,000
Oriente	44	9,074,790	8,680,000
	183	35,881,789	33,073,000
Tons		5,125,970	4,724,714

Sugar cane is grown fairly extensively in different parts of Angola and its cultivation is increasing, particularly in the Amboim district, where a large sugar mill, capable of turning out 10,000 tons of sugar annually, is at present in course of erection.

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[1] U. K. Patent, 181,303; *I.S.J.*, 1922, 497.

* Of 320 lbs.

The Sugar Industry in Cuba.

An Economic Survey.[1]

Cuba, the world's most important source of cane sugar, exported in 1924, 4,538,853 short tons and in 1923, 3,872,353 short tons of the raw product, largely to the United States for refining. It is estimated that at full capacity, the 180 mills now operating could manufacture 6,000,000 short tons annually. While various agencies estimate the annual production of the sugar mills, or centrals, none of them have an accurate gauge of the areas under cultivation, nor of the areas that might be adapted to sugar production to the point of supplying the centrals with cane enough to work at full capacity. The industry, therefore, is still pretty much at a loss for knowledge of current annual production on the basis of yields per unit of area, and the full potentialities of production are not known.

The importance of Cuban sugar in the world's economic life prompted the sending of a party of investigators, headed by Dr. W. F. CALLANDER, Senior Statistician in charge of Crop and Live Stock Estimates, United States Department of Agriculture, to study the sources of information in Cuba, and the methods used by the various crop estimating agencies. The results of the investigation showed, first, that none of the agencies now reporting on Cuban sugar are getting all of the available facts on which to base their production estimates ; and, second, that a more comprehensive survey of the areas of both present and potential production will reveal possibilities of greater production. There is an apparent tendency to concentrate the resources interested in grinding cane, at the same time increasing the output of sugar.

The centrals are scattered over the Island, from the Province of Pinar del Rio to the Province of Oriente, both included. About one-third of the mills are owned and operated by Americans. Sixty per cent. of the American-owned mills are in the two eastern provinces of Camaguey and Oriente. The other two-thirds of the mills are owned or controlled by Cubans and Spaniards, and a few by English and French interests. Most of the expansion in sugar production that has taken place since 1914 has been in the provinces of Camaguey and Oriente, in eastern Cuba. Vast amounts of American capital have been invested in the purchase of land and in construction of centrals in those provinces.

Some mill managers say that if the cane were properly cultivated, diseases controlled and good seed used, Cuba could make six million short tons with the additional land available. It appears unlikely, however, that this figure will be greatly exceeded, because some mills are not able, particularly in the western end of the Island, to get an adequate supply of cane from the area now given over to cane production, and because of such checks as cane fires, labour strikes and the like. It is said that there is a considerable amount of good land now in use in Camaguey and in Oriente as cattle land that could be brought into cultivation.

Exclusive of those lands, however, there are probably not over 330,000 acres of good cane land left unused on the whole Island. Cuba is endeavouring to make an industry of cattle raising, so it is believed that unless the price of sugar improves, the likelihood of the cattle lands being taken for sugar cane growing is remote. In the eastern provinces of Cuba it is said that at present good cane land may be had for about $60 per acre, and for about $150 per acre with the cane planted on it.

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[1] Prepared by the Bureau of Agricultural Economics in the U.S. Department of Agriculture, from the reports of an investigation conducted in Cuba by representatives of the Department. This survey was originally published in "Foreign Crops and Markets," the weekly Journal of the Department.

CUBA : EXPORTS OF RAW SUGAR BY COUNTRIES, CALENDAR YEARS 1913, 1920-24.*

Countries to which Exported	1913 1000 lbs	1920 1000 lbs.	1921 1000 lbs	1922 1000 lbs.	1923 1000 lbs.	†1924 1000 lbs.
United States ..	4,837,425	5,302,932	5,306,722	8,901,553	6,936,335	7,214,644
Argentina ...	—	—	—	4,678	—	—
Canada	53,442	201,870	46,530	172,659	86,910	151,567
Germany	3	9	—	13,310	1	—
Belgium	331	70,765	6,693	67,228	10,615	—
Spain	32	23,530	18,588	16,861	138	—
France	27,430	127,400	136,543	301,040	57,536	122,817
Holland	10,845	45,175	—	29,410	22,781	—
Italy	—	—	35,883	201	—	—
Mexico	4	91	86	—	—	—
United Kingdom	547,103	1,105,384	662,352	1,520,324	571,452	1,126,828
China	—	—	34,136	34,832	—	—
Japan	—	—	112,566	87,792	—	—
Poland	—	—	—	4,726	—	—
Other countries.	285	108,411	51,073	10,080	65,036	173,118
Totals ..	5,476,900	6,985,567	6,411,172	11,164,694	7,750,804	8,788,974

The Cuban Government has no late information on sugar areas or production. The agricultural statistics gathered and published by the Government are extremely meagre and incomplete. Few statistics have been gathered on any crop excepting sugar, and on that crop forecasts of production have been made only during the past two years. In December, 1924, a bulletin was issued by the Cuban Department of Agriculture giving very detailed statistics of sugar production for the 1923-24 campaign by provinces and by centrals. This bulletin is regarded generally as accurate and complete. It is said to have required months to gather the data, and hundreds of letters and telegrams were used to get the 180 centrals to report. On March 4th, 1925, the Cuban Government issued an estimate of 4,474,000 short tons of sugar for the present crop. They began on December 1st, 1924, to get the data for the report, and it is based almost wholly on reports of the mill managers. All available crop information comes from mill managers, colonos or growers, and brokers.

All private and public reporting agencies use these sources in compiling their estimates, some of them supplementing their data with each other's reports when necessary for presenting the completest picture possible. Two of the leading private reporters spend considerable sums annually to secure such returns. Failure to secure accurate acreage data is laid to the unreliability of the colonos' reports, who tend to overestimate their plantings when applying to the mills for advances to produce the crop. Accurate returns are available only for lands owned and controlled by the mills, some of which, particularly those American-owned, keep very complete statistical records of field operations. It seems to be the practice of the mills to draw up in advance early in the year what they call a planting programme, and many of the mills say they know positively by the beginning of summer what acreage of cane they are going to have for harvest at the next campaign, with the exception of cane not under contract or "free cane," weather interferences, cane fires and the like. The mill makes an estimate for its own lands and also for the lands under lease to the colonos.

The mill manager is the man who knows best each fall what his production of sugar is going to be. He has the very best opportunity of knowing. The field managers (jefes de campo) get in touch with the colonos during October and November and ascertain just how much cane they are going to be able to furnish the mill, and inspect the colonos' fields to see whether the colonos are correct in their statements. The more careful managers have two or more men making separate estimates of the same field, using one as a check against the other. Estimates are also made of the quantities of independently grown cane available to each mill. It is insisted that the latter part of November or early December is the earliest possible date that accurate production forecasts can be made, as the yield depends to a very large degree on the rains and temperatures in September, October and November. Until the effect of these rains and temperatures is known, mill managers are averse to furnishing estimates of production. Some of the centrals make a second estimate of their production at about the middle or towards the close of the grinding season, this second estimate being in the nature of a revision of their December estimate and based on later and better data. It is these later estimates by the mill managers, for the most part, that furnish grounds to the estimating agencies for revising their earlier figures.

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*Refined sugar exports converted to raw sugar equivalents. †Preliminary figures.

The apparent tendency, however, is gradually to increase sugar areas, although there is a very close relationship between the price of sugar and the plantings of cane. For example, this year, with the prices of sugar below three cents, reports from various sources are to the effect that the quantity of new land being cleared for cane is small, and that the acreage that will be available for harvest a year from this fall will be about the same as for the current year, with even a possible reduction where the yield of old cane has fallen too low to be profitable and the new acreage is not sufficient to replace abandoned land. With the planter, much depends on whether or not he will increase his areas upon the time at which he must plant, whether the ground will be moist enough when he is ready. But the only climatic condition that can interfere is the dry season, and that is also the grinding season. The grinding season begins usually about the middle of December or early in January, and usually runs from four to six months. While the area at present under cane is not likely to be much increased, it is true that there are possibilities of increasing yields through the proper use of fertilizers, control of diseases—especially the mosaic disease—drainage of lands, use of higher yielding varieties of cane, and the employment of better methods of cultivation. If every planter would follow improved methods, it is thought not too much to say that the yields could be almost doubled on the present acreage. Up to now, however, very little systematic work has been accomplished, and while some high-yielding varieties of cane have been developed, little progress has been made in their dissemination. The variety grown almost universally is known as "Crystalina."

A man planting 660 acres of cane is regarded as a small colono. Some colonos are said to plant as much as 3300 acres, and occasionally more. A colono after clearing the land and planting the cane has a lien on the subsequent crops harvested from the first planting. The party who purchases the ratoon from the colono assumes the colono's contract with the mill. Usually the mill makes settlement for cane delivered in cash rather than in sugar, but the colono may take the sugar if he desires. The price is determined every two weeks. When sugar prices are low, mill operators have more difficulty in borrowing ample money to conduct their operations. If the centrals are not able to get the money they need, they will not be able, of course, to finance the colonos, and that will automatically curtail plantings, since the contracting colono can not operate without funds from the centrals.

It appears that most of the good land is under the control of existing mills, and it is thought altogether unlikely that the number of mills will be substantially increased in the future. Indeed, it is regarded as possible that the number may be reduced because of consolidations and the abandonment of old sugar land which has ceased to be profitable for sugar production. Some of this old land is in the Provinces of Matanzas, Pinar del Rio and Havana. In Matanzas and Havana some such lands are being put into henequen, or sisal. Henequen gives promise of being a profitable crop for Cuba.

According to certain mill managers, there are three plantings of sugar in a year in Cuba: *Primavera* (Spring) planting, which runs from April to June inclusive. *Medio tiempo* (mid-season) planting is done in February and March, and *frio* (fall) planting, in October, November and December. By June the planting is finished for the approaching campaign. Spring planting is said to give the best yields, and some of this crop may be harvested towards the close of the first campaign after planting, at about the same time that the preceding *medio tiempo* cane is harvested. *Medio tiempo* cane does not yield so well as *primavera*, but gives second best yields. *Frio* cane runs from about one year to fifteen months from planting to time of harvest; that is, planted in the fall of one year, it is ready for harvest at the beginning of the second campaign after planting.

Yields vary according to the season and locality in which the cane is planted, according to some mill managers. Managers at centrals in Santa Clara Province, adjacent to Cienfuegos, say that new Spring plantings and new *medio tiempo* (mid-season) yield from 750 to 1000 short tons per unit of 33 acres, first cutting, but that *frio* or late planting does not do that well. Ratoons (stubble) give an average of about 500 short tons. In this particular area the ratio of ratoon cane to plant cane is given as 3 to 1. The heaviest yields are reported in the eastern provinces, where the lands are new and good in comparison with the middle and western provinces. Yields in Matanzas are said to run as low as 375 short tons per 33 acres when not fertilized, and some lands there with fertilizer yield as high as 625 short tons, the average for that province being about 560 short tons. Some mills there gave the yields in 1/10 acre units (*cordellas*) and the yield per *cordella* as 3125 lbs. of cane, equivalent to about 15·3 tons of cane per acre. In Camaguey yields range from 937 to 2500 short tons per 33 acres, first cutting, and no fertilizer used. An authority on cane in the field mentions yields in Camaguey province *as high as 3500 short tons per 33 acres on virgin land*, first cutting and no fertilizer used, and no cultivation. According to the same authority, in Camaguey Province the first year they get about 1250 short tons, and after the first cutting the land will yield well for about three or four years because the cane will have stooled out and have better roots. On land planted in 1914 one central is getting 937 to 600 short tons per 33 acres. In Matanzas Province it is told that after the first cutting the cane stools out better, so that the second, third and even the fourth cutting is as good as the first. After that the yield diminishes steadily. But the practice nevertheless is to keep cutting from the ratoons for a number of years.

The number of arrobas (25 lbs.) of sugar paid by the mills, per 100 arrobas of cane delivered, varies about the Island. It is highest in the middle and western provinces and lowest in the eastern provinces. Production is easier and cheaper in the eastern provinces by reason of the lands there being newly brought into sugar cane and yields being larger. Some centrals in Matanzas province say their contracts are for 150 lbs. (six arrobas) of sugar, with colonos not under contract getting as much as seven, seven and a quarter, and even seven and a half arrobas in some cases. In Camaguey and Oriente provinces, the contract figure is as low as 112 lbs. (4½ arrobas). In certain sections the colonos at present are demanding 125 lbs. (5 arrobas) of sugar, a figure thought by the mills to be too high.

Colonos make their contracts at an agreed price for a period of perhaps ten years. Usually the contract provides that the colono will receive so many arrobas (25 lbs.) of sugar for every 100 arrobas of cane that he delivers at the mill. If sugar prices fall low trouble sometimes occurs between the mill and the colonos, because the colonos want to throw over their contracts. More arrobas of sugar per hundred arrobas of cane are demanded, and if the demands are not allowed the colonos refuse to deliver the cane. When a central can not grind all of its available standing cane, the cane is sent to some other central for grinding. If that can not be done, the cane is allowed to remain standing until the next grinding season and is shown in the mill's statement of operations as green cane available for grinding during the campaign but left standing.

CUBA: ESTIMATES OF SUGAR PRODUCTION.

Year	Secretary of Agriculture, Commerce and Labour. Short Tons.	Secretary of the Treasury Short Tons	H A Himely Co[1] Short Tons.	Guma-Mejer Co[2] Short Tons.
1899-1900	336,082	317,689	—	345,568
1900-1901	712,159	686,308	—	712,159
1901-1902	952,203	967,447	—	952,203
1902-1903	1,118,738	1,124,338	,118,743	1,118,743
1903-1904	1,165,055	1,178,546	,165,055	1,165,055
1904-1905	1,302,849	1,325,349	,302,849	1,302,849
1905-1906	1,320,199	1,377,361	,342,599	1,342,599
1906-1907	1,598,994	1,618,187	1,598,994	1,589,994
1907-1908	1,077,393	1,085,588	1,077,393	1,077,393
1908-1909	1,694,965	1,704,436	1,695,212	1,695,212
1909-1910	2,020,871	2,035,649	2,020,871	2,020,871
1910-1911	1,661,465	1,670,151	1,657,843	1,661,465
1911-1912	2,123,502	2,142,420	2,120,929	2,123,502
1912-1913	2,719,961	2,737,264	2,720,749	2,719,961
1913-1914	2,909,460	2,891,281	2,908,155	2 909,460
1914-1915	2,921,984	2,967,427	2,892,786	2,903,787
1915-1916	3,398,385	3,436,649	3,367,419	3,368,865
1916-1917	3,421,597	3,441,771	3,382,328	3,386,566
1917-1918	3,889,966	3,957,061	3,857,958	3,859,613
1918-1919	4,490,902	4,596,710	4,443,145	4,448,389
1919-1920	4,183,676	4,209,349	4,176,452	4,177,686
1920-1921	4,406,413	4,451,010	4,407,685	4,408,365
1921-1922	4,517,470	4,532,904	4,475,732	4,475,953
1922-1923	4,083,483	4,086,781	4,033,798	4,035,259
1923-1924	4,606,223	—	4,538,853	4,554,639
1924-1925 estimate	5,011,216	—	5,712,000	5,516,000

The "free colono," not under contract, grows "free cane" on land owned by the colono himself, or at any rate not owned by the mill. He owes the mill nothing, so may sell his cane to whichever mill will pay him the highest price. It sometimes happens that there are a half dozen or more mills close enough for the free colono to sell to, and it becomes necessary for the mills to bid against one another for his cane. The highest bidder each year gets it. In one year a central might get as much as three million arrobas of free cane, and the next year it might not get more than one million, and maybe none at all.

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[1] H A. HIMELY quotes Willett & Gray for years previous to 1902-1903.

[2] Years previous to 1905-1906 quoted from Willett & Gray based on estimates made by JOAQUIN GUMA.

In the newly developed sections the land on which the cane is grown is owned for the most part by the mills. They plant some of the land themselves and they lease a portion of it under contract. In some instances land is leased by the mills from large landowners and sub-leased to the colonos. The mills advance money to the colonos, and fertilizer if they wish it. About $1500 and 70 bags of fertilizer per unit of 33 acres is the advance generally made. The colono uses the money to clear the land, plant the cane and work the crop, the mill in this way being able to control the amount of cane that the colono will plant. The plan is pretty much the same as that of the southern merchant in the States who finances the cotton planter. When a colono reports to the mill office that certain work has been done, the mill sends out a field inspector to check him up and see that the work has been actually done as reported, and this before any advance of funds is made. Sometimes through the inefficiency or dishonesty of a field inspector a false report is returned to the mill office, although this seldom occurs.

As a complement to the above statistics of yields in Cuba, it may be convenient to add here some data as to the cost of producing sugar which the Czarnikow-Rionda Company of New York gave the readers of their weekly report a short time ago.

"While no definite figures (they wrote) have been determined, it is generally admitted that the lowest price at which the most favoured Cuban plantations can place a lb. of 96° centrifugal sugar f.o.b steamer is 2½c.; others, not so well situated or having higher cost of cane, must have 2¾c. f.o.b. to cover their initial cost. Still others, among the smaller plants, need 3c. f.o.b. to come out even.

"In every case the above-mentioned costs exclude fixed charges, such as interest on bonds, depreciation and taxes, which items, varying in almost each case, are impossible to calculate as to the share they contribute toward the cost of the article.

"The main items that go to produce sugar are: (*a*) cost of cane, (*b*) cost of manufacturing, in which are included railroad freights, the empty bag and shipping expenses.

"With regard to the cost of cane it is reasonable to estimate it per lb. at between 1·50c. and 1·75c. The percentage in sugar given by the planter to the colono in exchange for the cane as well as the yield of sugar per ton of cane, are the principal factors that govern the cost of cane. The figures taken here are the lowest possible, and are not very remunerative to the farmer.

"In the manufacturing, railroading, and other items there is also great disparity, depending on the size of the mills, distance from the seacoast, and cost of shipping. For our purpose we will calculate the lowest cost of manufacturing at from 1·00c. to 1·25c., making an approximate cost f.o.b. of 2·50c. and 3·00c.

"From the above figures it is easily seen that the average cost of producing sugar in Cuba must be much above 2½c. f.o.b. This explains the great resistance on the part of producers to accept lower prices, and the consequent quick reaction immediately the market touches 2½c.

"To the f.o.b. cost price in Cuba, the lowest of which for our present purpose we will consider on an average of 2·75c. f.o.b., there is to be added marine freight of 0·15c. and Customs duty of 1·76c. This makes the duty paid price 4·66c."

Settling Tanks, Juice Strainers, Pumps, etc., in Hawaii.[1]

By ARTHUR F. EWART.

SETTLING TANKS.

Of the many settlers which have been introduced, the Deming was perhaps the best known; and **Noël Deerr** described it in his book of 1905,[2] where there are also reports on its operation by **Beeson**, **Edson**, and **Geerligs**.

The modern Ruckstuhl settling tank (Fig. 1) has all these principles, but has a number of cones instead of one, thereby multiplying its efficiency and capacity [3] Cross sections have been proportioned for the most advantageous juice velocities and the concentration of the heavier impurities in the funnel-shaped, acute-angled bottom. Such a juice settler is superior in effectiveness and simplicity to most of the preceding designs.

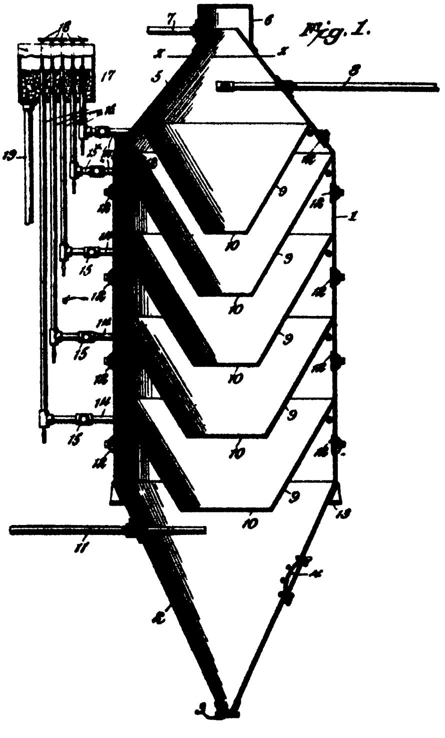

FIG. 1.

Its operation is as follows:—Dirty juice enters the tank through pipe *8*; the scum rises to trap *6*, and flows out through pipe 7. From the descending juice the heavy impurities strike baffles *9*, and travel down the steep decline in a concentrated state through openings *10*. They next travel at a very low velocity up to the discharge pipes *14*, *14*; and the remaining heavier solids have a chance to settle out before reaching the discharge. Finally, the clear juice flows into rending tank *17*. The settler is provided with regulating valves from each compartment and delivery pipes for the clear juice.

An important feature of this apparatus is the very steep slope of the cones assuring the downward movement of precipitates. In the lower cones, mechanical means are employed to move and compress the heavier and more concentrated precipitates toward the mud discharge *3*. As indicated in the figure, the mechanism of the revolving parts is compact and simple.

MILL JUICE STRAINER TANK.

Fig. 2 shows the cross-section of a juice strainer and mill juice tank, designed by E. W. **Kopke**, of Manila, that is much favoured in the Philippine factories. This design should indeed prove to be useful anywhere, especially where the troublesome jelly-like *Leuconostoc* forms, causing loss of sucrose and obstruction of the flow of the juice.

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[1] Abstracted from a Report presented to the Third Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, October 27th, 1924.

[2] "Sugar and the Sugar Cane." **Noël Deerr**. 1905. Pages 152-153.

[3] *I.S.J.*, 1923, 502; 1923, 656; 1924, 71; also U.S. Patent, 1,543,621; *I.S.J.*, 1925, 562.

It consists of a tank which extends the horizontal length of the strainer, and serves the purpose of mill juice tank, while supporting the superimposed strainer *B*. This is of the slat-scraper type, as commonly used, but has the perforated sheet-brass strainer made up in removable sections or panels *C*. Tank *A* is wider than the slat-scraper. By removing the covers *D*, any or all the strainer panels can be removed, making every part of the apparatus accessible. A workman can comfortably enter the tank for cleaning purposes; and, besides the feature of accessibility, the apparatus has a system of steam pipes (not here shown) by which it can be thoroughly disinfected throughout.

Unstrained Juice Pump.

This pump has already been mentioned[1] (see Fig. 3). Under the care of the Oahu Sugar Company's engineering staff a new type of valve has been developed. It has worked successfully during the seasons 1923-24, and is now beyond the experimental stage.

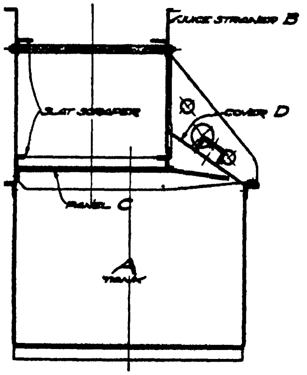

FIG 2

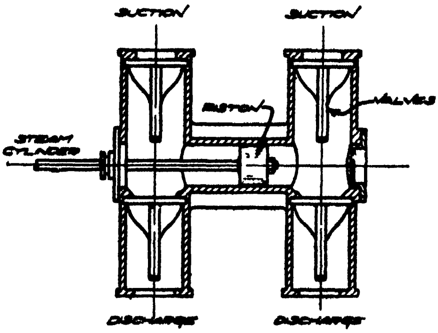

FIG. 3

The design of such a pump, and the persistency with which it has been developed, were prompted by the fact that the juice strainer, as usually used in Hawaii, and in other cane sugar countries, has some very objectionable features.

As the result of the intimate mixing of the juice with air (occurring in the strainer) souring is induced, this causing a loss of sugar by inversion. Further, the screenings containing the lowest density and lowest purity liquor are dragged by the slats over the perforated brass screen from the last mill through the discharge of juice of higher density and purity of the preceding mills until it reaches the inflow of the normal juice from the crusher and the first mill. The low density and low purity juice in the screenings of the last mill is displaced to a large extent by richer and purer juice, and this passes through the mills with the bagasse blanket. In this way the rich pure juices are contaminated and the maceration is enriched.

These two very objectionable features are to a large extent, if not entirely, eliminated by the use of the unstrained juice pump. W. L. McCleery, of the H.S.P.A., stated at the Sugar Section of the Pan-Pacific Conference that in a series of tests on the increase of acidity per 100 of density through both tandems at Oahu factory, he had found considerably less increase in the mill with the unstrained juice pump than in the other mill equipped with the usual strainer.

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[1] *I.S.J.*, 1924, 89.

LUBRICATION OF CENTRIFUGALS, ETC.

Due to two noticeable reasons, lubricating ball-and-washer bearings of centrifugals is the cause of much trouble locally. The first and most important reason is the use of the wrong kind of lubricant. An oil consisting of a medium grade of engine oil, with which there is blended about 15 to 20 per cent. of acidless or winter-strained lard oil, has been found to give the best results on both types of sugar centrifugal bearings. In some cases a medium hard grease is being used for the ball bearings. But unless the bearings are completely packed with the grease, and the grease does not creep or flow to balls and races, there is simply a groove cut through the body of the grease, and the bearings are soon operating metal to metal, which, it is obvious, quickly sets up a cutting of races and scoring and chipping of balls. When such a condition once develops, there is nothing which can lubricate the bearings; consequently the destruction of the bearings gradually increases to a point where replacement of balls and races becomes necessary. Since all ball bearings are surrounded by leak-proof encasements, it is clear that an oil would be eminently more reliable than any solid or semi-solid lubricant.

This matter of the lubrication of sugar centrifugals suggests the question whether too many different grades of oils are not being used. Would it not be better to use say three grades of oil for sugar factory lubrication? For instance, a good grade of steam cylinder oil, carrying sufficient compounding to efficiently meet the lubricating requirements in all types of steam cylinders operating at steam pressures between 95 and 125 lbs. per sq. in. This type of oil has sufficient compounding to give excellent roller bearing lubrication. It could also be used in worm drives, and in all other bearings where practice shows a heavy oil to be required.

Next, a medium grade of so-called high speed engine oil could be successfully used on all types of sleeve and ring oiled bearings. This would include bearings of engines, steam turbines, dynamos, motors, centrifugal pumps, etc. These two grades with the special oil for sugar centrifugal bearings could be made to fully meet all lubricating requirements of the average sugar factory, and would practically eliminate the possibility of oilers and engine tenders using the wrong oil. It might be well to record here the importance of using a good and dependable grade of lubricating oil. By selecting oils of reputable quality rather than of cheap quality, many expensive repairs and shut-downs now directly traceable to improper lubrication and improper selection of lubricants would be eliminated.

That the value of the work carried out at the Imperial College of Tropical Agriculture in Trinidad is appreciated throughout the Empire, is shown by the steadily increasing list of donors to the Special Appeal. Contributions may be sent to Mr. ALGERNON ASPINALL, C.M G., Secretary, 14, Trinity Square, London, E.C.3.

Imports of refined sugar into Ceylon increased during 1924 by about 25 per cent. Of the total amount imported, Java supplied five-sixths, as against four-fifths in 1923. Imports from Hong Kong and the Straits Settlements also increased. India only shipped 40 per cent. of her last year's total, but maintained her place as a supplier of coarse sugar.

The *Glasgow News* reports that in order to meet the requirements of the rapidly developing beet sugar industry in Scotland, the Governors of the Royal Technical College, Glasgow, have added a beet-rasping machine to the equipment of the laboratories, and plans have been drawn of an installation of tanks, in which the treatment of the beet juice can be illustrated experimentally. Arrangements for the supply of juice for this purpose have been made with the officials of the new Greenock factory.

Determination of the Hydrogen-ion Concentration in the Cane Factory, using Indicators.[1]

By H. A. COOK.

INTRODUCTION.

During the past few years our conception of "acidity" and "alkalinity" has undergone a radical change. There is no necessity here of going into the details of the ionic theory, or a discussion of the dissociation of acids or bases. It has been thoroughly demonstrated that there is a dissociation of the H-ions and the degree of this dissociation is the important consideration in acidimetry.

In all aqueous solutions there are at all times both dissociated and undissociated ions, which in a solution are dissociated to different extents. The modern conception is that there is a constant movement, attraction and repulsion, between these ions which are electrically charged, the hydrogen-ions carrying a positive charge and the hydroxyl-ions a negative charge. It, therefore, is a question of the activity of the hydrogen-ions with which we are concerned.

Until very recently all reference to reaction values, where any definite values were expressed, has been in terms of "total acidity" or "alkalinity." In the beet sugar industry these terms have had a quite definite meaning and are usually expressed as "grms. of CaO per 100 c.c.," but in cane practice there has not been as close an expression of the values, though sometimes c.c. of some normality of acid or alkalinity are mentioned. The more common expression found is "slightly acid to litmus" or "slightly alkaline;" but often the indicator used was not mentioned. The expression of results at the Hawaiian Experiment Station has been "grms. CaO per 100 c.c."

This loose application of the terms acidity and alkalinity has resulted in considerable confusion. It has made it extremely difficult to correlate the results obtained by one factory with those of another, or of one man's work with another. The results of much valuable research work has been lost, due to inability to interpret the results into values that had definite meaning. The introduction of the ionic theory with a better understanding of the meaning of the terms hydrogen-ion concentration and *pH* values, and the consequent more exact expression of the "acidity" or "alkalinity," together with improved means of measuring these values, has developed among scientific men in general an appreciation of how indefinite were those old terms "slightly acid," "distinctly alkaline" and "neutral."

APPLICATION TO CANE FACTORY CONTROL.

Investigations on clarification carried out by Mr. BOMONTI at the Hawaiian Experiment Station demonstrate that the best results in clarification and the largest increase in purity were secured by liming the cold raw juice to a faint colour to phenolphthalein. At that time a hydrogen-ion apparatus was not available and it was believed that a reaction existed in the clarified juice which could be expressed in terms of titratible alkalinity to litmus as an indicator. Later, it was found that this relation did not exist. It has since been found that liming to this point corresponds to 8·8 *pH*.

Investigations on the digestion of juices at high temperatures further clearly demonstrate that there is a definite reaction, below which juice will not keep, without inversion, over a period of 22 hours. This reaction is directly related to hydrogen-ion concentration or *pH* values and does not have any relation to total acidity or alkalinity.

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[1] A Paper presented to the Third Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, 1924 (here abridged).

More recent investigations, by the writer, substantiate Bomonti's findings and will probably establish more definitely the hydrogen-ion concentration at which inversion takes place in clarified juices. We also expect to be able to establish the rate of inversion at the different hydrogen-ion concentrations, and to establish the rate at which clarified juices become acid at different initial reactions and at different temperatures.

It is a definitely established fact that there is a narrow margin of hydrogen-ion concentration at which the maximum results in clarification are obtained. We believe that there is a definite hydrogen-ion concentration below which inversion may be detected in clarified juices. The inversion of sucrose in clarified juices begins at a much more alkaline reaction than was heretofore realized. The inversion of pure sucrose has, for years, been used as a measure of hydrogen-ion concentration, but it has not been established that there was just as definite a relationship existing in clarified juices.

Cane juice can roughly be described as a complex aqueous solution containing sugar, and therefore both hydrogen-ions and hydroxyl-ions. Raw juice contains an excess of hydrogen-ions and clarified juice usually contains an excess of hydroxyl-ions.

There have been many conflicting statements made as to how acid a juice may be allowed to become before there is any danger of loss by inversion. Authorities have definitely stated that the juice can be carried "neutral" or "slightly acid" to litmus without loss from inversion. But we have found at the Experiment Station that inversion does take place in juices that are definitely alkaline to litmus and even definitely alkaline to true neutrality.

Placing the chemical control of the sugar factory on a hydrogen-ion concentration basis involves means for this determination. First, there is the electrolytic measurement by means of the hydrogen electrode; and second the colorimetric method using indicators. The former method is, for commercial purposes, the most rapid, convenient and accurate, but is not yet adaptable for general use in sugar house laboratories. On this account it will not constitute a part of this paper.[1]

But in regard to the colorimetric method, it may firstly be remarked that indicators should be selected in reference to their sensitivity, their freedom from salt and protein error, their definiteness of colour change and the proper *pH* range of the indicator. The introduction of improved indicators, the charting of their *pH* ranges, better definition of degree in "acidity," or "alkalinity," make this method a desirable one for our purpose.

LITMUS AND PHENOLPHTHALEIN.

Litmus and phenolphthalein have been the almost universally used indicators for sugar house control. Litmus has played an important rôle in acidimetry and should be given full credit, but its use in other than the cane sugar industry has now almost become obsolete. It is not a reliable indicator for sugar house control. Its colour change takes place through a *pH* range of 4·5 to 8·3, and the so-called neutral point to litmus is approximately 6·3 *pH*. The *pH* range is so broad that the colour change is very indefinite and the approximate *pH* value of any hue cannot be definitely determined, besides which the neutral point is so far on the acid side of true neutrality that this point is valueless, true neutrality being *pH* 7·0. Moreover, litmus is a complex of many compounds, chief among which are azolitmin, erythrolitmin, erythrolein and spaniolitmin. Of these, azolitmin is the most important; but the azolitmin of commerce is of uncertain composition.

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[1] Further information can be obtained from numerous sources, notably, "The Determination of Hydrogen-ions," by W. MANSFIELD CLARK.

Preparations of it on the market are of variable purity and seldom is a pure product obtained.

Phenolphthalein is of comparatively recent use in Hawaii and is the best indicator yet found for its purpose. It is a one colour indicator and has a *pH* range from 8·3 to 9·8, depending a little on the concentration used. The concentration used in the clarification investigations was 0·1 per cent. At this concentration it first shows colour at about 8·3 *pH* in colourless buffer solutions. In cane juice it does not show colour till about 8·6 to 8·8 due to the natural colour and turbidity of the juice. This appearance of colour is quite definite and regular in different juices.

COLORIMETRIC METHODS, USING INDICATORS.

Colorimetric methods in use for the determination of hydrogen-ion concentration values are all based upon the use of buffer solutions and appropriate indicators. Only what is known as the spot test method will be described in this paper; that as far as can be learned was introduced by L. D. FELTON.[1] It is now used for the control of some of the sugar refineries on the mainland, and also by a few of the mills in Porto Rico. H. Z. E. PERKINS[2] has described the method in use at the American Sugar Refinery at Chalmette, La., whilst a previous article was published by BREWSTER and RAINES.[3] Buffer solutions were used as the basis of these comparisons, but Crockett Refinery was probably the first to apply the spot test method without the use of buffer solutions.

It must be understood that the colorimetric method, at its best, is an approximation of the true value, but with indicators and methods so far developed, results are secured which should check to within 0·2 *pH*. Adaptions of the method can be used which are of distinct value, and are without doubt far superior to the present method of expressing reaction values.

One of the main objections to the use of the regular colorimetric method is the use of buffer solutions, which are troublesome to prepare. Very pure chemicals repurified by several recrystallizations must be used. Several sets of buffer solutions have been made up at the Station following the directions of CLARK,[4] but these have had to be adjusted considerably before use, due to the purity of the chemicals used or to other reasons. They cannot be counted upon to retain their values for any definite length of time, even though it is, of course, always assumed that precautions are taken to avoid contamination and maintain perfect cleanliness in operations. It is important, moreover, that they be frequently checked with the hydrogen electrode.

It is desirable, therefore, if possible, to develop a method, by which the advantages of the colorimetric method can be retained, yet the use of troublesome buffer solutions be avoided. The only way we have found it possible to do this is to prepare standard colour charts which are in agreement with standard buffer solutions with the indicator added.

There are certain rules which must be conformed to in using this method:—Conditions must be comparable to those under which the standards were prepared. Indicators of the highest purity must be used. The same concentration of indicator must be used. The depth of indicator colour in the spot plate must be the same. The same amount of indicator and sample must be used as was used in preparing the standards. Cleanliness must be observed.

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[1] *Jl Bio. Chem.*, 1917, 46, 299.

[2] *Ind. and Eng. Chem.*, 1923, 15, 623.

[3] *Ind. and Eng. Chem.*, 1921, 13, 1043.

[4] MANSFIELD CLARK, "The Determination of Hydrogen-ions," p. 128.

APPARATUS USED AND METHOD OF PROCEDURE.

Equipment required includes 8 oz. glass stoppered bottles for stock solution of indicators; 1 or 2 oz. dropping bottles for use with the indicators; a spot plate with depressions 7 mm. deep and 20 mm. diam.; and 1 c.c. pipettes.

Four drops of the appropriate indicator are placed in the depression of the spot plate;[1] and to this 1 c.c. of the sample is added, a moment being allowed for the dissemination of the indicator through the sample, stirring not being advisable. This colour is then compared with the colours of the chart, and the *pH* value with which it coincides is taken for the *pH* value of the sample.

It is desirable that the readings be checked by overlapping indicators. For instance, cresol red covers most of the range of phenol red, and thymol blue overlaps a large portion of the higher range of cresol red.

Where the colour or turbidity of the juice interferes with the colour of the indicator, dilution may be resorted to. In a well-buffered solution, especially one around the neutral point, *pH* 7·0, dilution affects the *pH* valve to a very slight extent. The error increases the farther the value lies in either direction from the neutral zone amounting to 0·1 to 0·3 *pH*. A 1·3 or 1·5 dilution will be sufficient for nearly all cases. Test tubes marked at 5 c.c. and 20 c.c. for the 1·3 dilutions and at 5 c.c. and 30 c.c. for the 1·5 dilutions, are used.

INDICATORS AND THEIR CONCENTRATION FOR USE.

To cover the full range of reactions of the juices found in the sugar-house several indicators will be required, viz., brom cresol purple, brom thymol blue, phenol red, cresol red, thymol blue and phenolphthalein. In practice, two or possibly three indicators will serve all purposes, probably phenolphthalein together with phenol red, cresol red or thymol blue.

CLARK[2] advises for the preparation of these stock solutions that 0·01 grm. of the dry powder be ground in an agate mortar with the quantities of N/20 NaOH stated in the following table:—

INDICATOR	COLOUR CHANGE.	*pH* RANGE.	c c. N/20 NaOH.
Brom cresol purple	Yellow-purple	5·2-6·8	3·7
Brom thymol blue	Yellow-blue	6·0-7·6	3·2
Phenol red	Yellow-red	6·8-8·4	5·7
Cresol red	Yellow-red	7·2-8·8	5·3
Thymol blue	Yellow-blue	8·0-9·6	4·3

He makes these up to 25 c.c. with distilled water for stock solutions and dilutes them in the dropping bottles to a concentration of 0·02 per cent. for phenol red and cresol red; and 0·04 per cent. for the others; we have found, though, that it is just as well to make immediately up to 250 c.c. with distilled water thus making in all cases a 0·04 per cent. solution.

Phenolphthalein should be made up in 0·1 per cent, solution in alcohol and then diluted with water so that the alcoholic strength is approximately 50 per cent. by volume. The acidity of the alcohol is neutralized by adding N/100 NaOH to a slight pink, then adding one drop of N/100 sulphuric acid.

APPLICATION TO CANE FACTORY PRACTICE.

MCCLEERY and SMITH both experienced some difficulty in the use of brom thymol blue, obtaining results which averaged about 0·8 *pH* too low. Until we have determined the cause of this, we do not advise the use of this indicator.

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[1] Some plates have substances on the surface of the plate or in the glazing which cause some degree of ionization. Such a condition is usually overcome by letting a mixture of sulphuric and chromic acids stand for an hour or so on the surface of the plate, which is afterwards washed thoroughly with distilled water. It is well to follow this procedure every few days.

[2] *Loc. cit.*

Anyway, the range is lower than is usually needed for factory practice. We have found, too, that we can extend the range of phenol red a little lower and thus overlap with brom cresol purple for the lower range.

For conditions where the phosphoric acid content of the juice is such that the liming can be carried to the point advised in clarification practice, phenolphthalein is the best indicator to use. Cold raw juice should be limed to a slight colour to phenolphthalein, this giving a reaction close to 8·8 *pH*, and the clarified juice from this liming should not fall below 8·0 *pH*. The reaction of the clarified juice should be as carefully controlled as the reaction of the raw limed juice, for which point either cresol red or phenol red can be used.

If for any reason it is not possible or desirable to carry the liming to the extent above stated, it is possible to establish a definite reaction and control it by the use of one of the above indicators. If a point is used lower than that which has been found advisable, it should be made as high as possible, and the control maintained as carefully as at the higher point. As stated before, litmus should not be used for the basis of control, for a definite reaction cannot be established by its use. If it is desired to lime between the litmus value and phenolphthalein, a neutrality reaction of 7·0 can easily be established with phenol red by liming to a faint pink. If 7·5 is desired, a faint pink to cresol red will give this point; if 8·0 or 8·2 is wished, it can be secured by liming to a distinct red to cresol red or a faint blue to thymol blue. Where a factory wishes to lime to a faint alkalinity to litmus, or an acid reaction, it can be secured much more definitely by using brom cresol purple and liming to a faint purple.

It is not claimed that the adoption of this method will be a cure-all for the troubles in cane sugar practice. There will undoubtedly be difficulties experienced in using the method and in some cases difficulty in matching colours. As stated before, the use of indicators is only an approximate method. It will, however, be a step far in advance of present practice and will eliminate much of the guesswork in factory clarification control.

Publications Received.

Motor Fuel from Molasses. (The Walter E. Lummus Co., of Boston, Mass., U.S.A.; and 109, Kingsway, London, W.C. 2.) 1925.

This small book, the printing, illustration and binding of which are very commendable, summarizes in Part I the present position in regard to the world's supply of motor fuel; and subsequently discusses alcohol as a motor fuel; alcohol-ether motor fuel; patented mixtures; performance comparisons; relative advantages; engine corrosion not proved; market for alcohol-ether motor fuel; and the cost of producing alcohol-ether motor fuel. In Part II it deals with processes and machinery; the manufacture of alcohol-ether motor-fuel; ether generation; and blending and mixing. In Part III it discusses special features of Lummus motor fuel plants; Lummus standard plants; Lummus engineering; and data necessary for estimating.

British Guiana. (British Guiana Section, British Empire Exhibition, Wembley, London.) 1924.

Contents.—Introduction; geography; Kaieteur Falls; population; fauna; flora; timber and forest industries; sugar, rice, and agricultural industries; commerce and shipping; and opportunities for capital. Under the heading of sugar there are data on acreage; capital; cost of production; methods of cultivation; exports; labour; and Demerara rum.

Publications Received.

Auf dem Wege zur Spodiumlosen Weisszucker-Erzeugung und Raffination. By Dr. Oskar Wohryzek. Tagesfragen aus der Zuckerindustrie. (Albert Rathke, Verlag, Magdeburg.) 1925. Price: 2 gold marks (unbound).

This is the first of a new series of booklets, entitled "Questions of the Day in the Sugar Industry," which is being published by the well-known firm of Albert Rathke. It deals with the production of white sugar in Continental factories, and consists of data on the history and application of bone-char, and largely with substitutes for it, decolorizing carbons in particular. In fact, most of the space is taken up with recording information on various carbons, such as "Norit," "Carboraffin," "Idealcarbon," "Eponit," "Polycarbon," and "L and V" carbon, the first two being given special attention. Most of what Dr. Wohryzek has to say will not come as news to readers of this *Journal*, though the pamphlet is of interest, as it is the first to be published in any language dealing with the subject of decolorizing carbons. It is clear from a perusal of these pages that the problem of the application of carbons in beet factories is a different one from that which concerns the production of plantation white sugar with their aid. As a summary of a good deal of the data recorded hitherto on carbons, this contribution by Dr. Wohryzek will be found useful and will doubtless be appreciated.

Die Fabrikation des Stärkeszuckers By Dr. R. E. Preuss. (M. Janecke, Leipzig.) 1925. Price: 16.2 marks.

This is a good work on German methods for the production of starch sugar, and is by a prominent practician. It is well illustrated, and will be found of value by the glucose manufacturer.

Principles and Practice of Industrial Distillation. E. Hausbrand; translated by E. Howard Tripp, Ph.D. Medium 8vo.; 312 pages; with 21 figures, 68 tables, and 16 charts. (Chapman & Hall, Ltd., 11, Henrietta Street, London, W.C. 2.) 1925. Price: 21s. net.

Although there are many good books on distillation in the English language, none of them covers the same ground in the same way as "Hausbrand." His authoritative work on the mechanism and mode of action of distilling apparatus has attained the rank of a standard treatise in Germany, and elsewhere, and those who have been able to master its language prize it very highly. For these reasons it has been decided to publish an English version for the English-speaking world. In Part I are considered the theoretical principles upon which the art is based, and in Part II, the application of these principles to the calculation of the required dimensions of fractionating columns of various types of apparatus, including that for the continuous distillation of alcohol. In Part III are included numerous tables; and Part IV consists of various charts.

Annual Report of the Agricultural Experiment Stations of Louisiana State University and Agricultural and Mechanical College for 1924. By W. R. Dodson, Director. (Baton Rouge, Louisiana, U.S.A.). 1925.

This Report deals with the activities of the Louisiana Experiment Station, and gives promise of some valuable results probably to be published later. Mr. J. F. Brewster, Research Chemist, believes that a means has been found in his laboratory to prevent, at least temporarily, the rise in acidity when cane juice is treated with milk-of-lime in the cold as is done in clarification in Louisiana, though its cause has not been satisfactorily explained. During the period under report he was engaged also on the preparation of decolorizing carbon, and obtained some very satisfactory preparations. He has collaborated with the A. O. A. C. in their work on the establishment of methods of analysis; and has co-operated with the Bureau of Chemistry in work on the nutrition value of the sugar cane. Dr. Wm. L. Owen, Bacteriologist, has worked on his interesting and promising studies on the prevention of the deterioration of raw sugars by torula inoculation.

He has experimented on the optimum *pH* concentration for the maximum efficiency in the alcoholic fermentation of blackstrap molasses; and also on the utilization of certain cultures for the production of higher alcohols and acetone.

The Story of Sugar. By C. F. Bardorf, F.I.C. (Canada). (Williams & Norgate, London.) 1924. Price: $1.50.

Mr. Bardorf, joint-author with Mr. J. A. B. Ball of "The Elements of Sugar Refining," which was reviewed in these columns last month,[1] here writes in quite a different vein, this book being of a popular nature, descriptive of the whole "story" of sugar. It discourses on "Sweetness in General"; "How Sugar is gathered from the Elements"; "From Mangel-Wurzel to Mother-Beet"; "The Birth of a Crystal"; "From Pan to Sack"; "Agents of Purification"; "The House of Caverns (Char Cisterns)"; "The Family Circle," etc., in a particularly illuminating yet accurate manner, it being possible even to say something about the chemistry of the sugars, beet selection, the nature of crystallization, and colloids and crystalloids. It is the best work which we have met for putting into the hands of our young people for their initiation into the nature of sugar, its history, its cultivation, its production in the raw state, and its refining. It is written in the autobiographical form, a happy idea in a very elementary book of this kind, interest in the narrative being thus sustained.

An Introduction to the Literature of Chemistry. By F. A. Mason, M.A., Ph.D., F.I.C. (At the Clarendon Press, Oxford.) 1925. Price: 2s. net.

Chemists engaging in research have experienced the difficulty of making a search through the literature bearing on the matter they have under investigation. Dr. Mason here directs them to the actual literature (the dictionaries, chemical journals, abstracts journals, textbooks and works of reference), and also instructs them in the manner of making the search. He indicates the nature, purpose, and relative value of the various works of reference; and a useful addendum is a chronological chart showing the dates of the existing indexes of chemical periodicals and reference books. It is, so far as we know, the first work of its kind in English, and there is little doubt that it will largely realize the useful purpose for which it is intended.

P-W-R Manual. (Powers-Weightman-Rosengarten Company, Philadelphia, Pa., U.S.A.) Fifth Printing. 1924. Price: $2.00.

This is a well-known pocket-book for the analyst and pharmacist published by one of the oldest established firms of manufacturing chemists in America. It presents data on the metric system of measures and weights; comparison of the latter with the U.S. and British systems; conversion formulæ; thermometric equivalents; and comparison of hydrometer scales. Specific gravity tables are given for a good number of chemicals; but the main part of the book is taken up with physical and chemical information relating to a large number of chemical and pharmaceutical substances. It is a most useful work of reference.

Companion to the First Edition of Chemical Synonyms and Trade Names. By William Gardner. (Crosby, Lockwood & Son, London.) 1925. Price: 7s. 6d.

When reviewing the first edition of this work,[2] we predicted its success as a work of reference to the chemist, manufacturer, and business man, and this has proved to be so. Its scope is now extended in this "Companion," which contains additional definitions and cross-references, these with those given in the first volume making nearly 1700 entries in all. It forms therefore a valuable work of reference for the chemical industry and those connected in any way with it.

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[1] *I.S.J.*, 1925, 562.

[2] *I.S.J.*, 1924, 166.

Revolutionizing Sugar Refining.

THE GENERAL NORIT COMPANY ANNOUNCES THAT IT IS NOW PRODUCING A NEW TYPE OF CARBON ALSO POSSESSING THE KNOWN FIBROUS STRUCTURE, WHICH IS A STILL BETTER FILTERING MEDIUM AND HAS A DECOLORIZING CAPACITY 5 TIMES THAT OF THE WELL KNOWN ORDINARY QUALITY NORIT. THIS SUPRA NORIT IS UNEQUALLED BY ANY OTHER DECOLORIZING CARBON OR BLEACHING MEDIUM ON THE MARKET.

NORIT PROCESS REPLACES BONECHAR PLANTS ALREADY INSTALLED—WHICH HAVE BEEN ABANDONED.

Cane Sugar and Beet Sugar Refineries—after having applied the **NORIT PROCESS** for a number of years—have abandoned their bonechar plants and have replaced same by installations to refine raw sugar by the **NORIT PROCESS** only

The main advantages are: A much smaller char plant and building to house same required, costing less; accelerated work and much smaller sugar losses, therefore a larger yield of sugar; less sweetwater and no necessity of separately evaporating the sweetwater; all sweetwater is pure and clean and is used entirely for melting sugar, so that there is no excess of sweetwater; eliminating the pre-filtration over cloth as the filtration and decolorization of melted liquor are done in **one** operation; small amount of carbon in circulation and to reburn daily; less consumption of steam and fuel, resulting in a fuel-saving of about 25 per cent as compared with bonechar work. Melted liquors can be economically filtered at **large rate** and decolorized at the same time at densities up to 70° Brix for beet and cane sugar solutions. The total cost of refining by the NORIT PROCESS is less than when applying bonechar. It is possible by the NORIT PROCESS to also refine economically small quantities of raw sugar daily.

Refined sugar made by the NORIT PROCESS is equal to the best bonechar granulated sugar. All grades, as cubes, loaves, golden syrup, etc., can also be manufactured.

NORIT is a vegetable decolorizing carbon in a fine state of sub-division, and the **only** available carbon that possesses **a special (fibrous) structure** and combines the properties of being an unequalled filtering medium and an excellent decolorizer, which enables successfully and without pre-filtration the filtration and decolorization of sugar solutions in **one** operation.

NORIT is the **only** vegetable carbon with a decolorizing power 30 up to 150 times that of bonechar (depending on the quality of sugar treated and on the quality of **NORIT** used) **NORIT** is actually in practice revivified by reburning more than 100 times, and after regeneration successfully used over again The decolorizing capacity of bonechar can not be exhausted in practice as much as that of **NORIT.** After a pre-filtration over cloth, 100 per cent resp 15 per cent of bonechar is wanted to accomplish the same result of decolorization of washed cane sugar resp beet sugar melt to produce the best refined sugars for export as about 1-3 per cent of ordinary **NORIT** on cane- and 0 25 - 1 per cent of ordinary **NORIT** on beet sugar, doing the filtration and decolorization in **one** filtration The above means that 1 lb of **NORIT** is good for about 6000 lbs of raw sugar, and that 1 lb of bonechar is good for only about 400 lbs. of raw sugar.

The cost of a NORIT installation is about one-fifth of that of an installation under the bone-char system. A NORIT installation consists mainly of mixing tanks and filter-presses, the only essential machinery not already available in a raw sugar house is mainly our patented reburning kiln and an acid vat to regenerate the spent NORIT

Any Raw Beet or Raw Cane Sugar Factory can—with NORIT PROCESS—produce its own refined granulated sugar in a quantity and a quality equal to or better than that obtained by the best equipped and best managed bonechar refinery, and at a much lower cost.

NORIT PROCESS USED IN CONJUNCTION WITH EXISTING BONECHAR PLANTS.

Cane Sugar and Beet Sugar Refineries are using NORIT in conjunction with bonechar, if bonechar plants are already available.

The main advantages are: Replacement of existing cloth pre-filtration by a NORIT filtration which causes also a large decolorization, which enables to either reduce the use of bonechar by about 50 per cent., or to increase the capacity of the bonechar plant by 50 per cent, allowing working up more sugar. Either case is advantageous and involves large savings in cost, increase of sugar yield and improvement in the quality of refined sugar produced.

The NORIT PROCESS applying Norit, a vegetable highly activated and fibrous carbon and revivifying same for re-use is IN USE SINCE 1911, and **IS STILL THE ONLY PROCESS** IN PRACTICAL USE IN THE CANE AND BEET SUGAR INDUSTRY whereby decolorizing carbon, other than bonechar, is used and re-used after revivification

GENERAL NORIT CO., Ltd.

Head Office: den Texstraat 2, AMSTERDAM. Holland.

The

MAXWELL

Is authoritatively acknowledged to be the first and only "Crusher-Shredder" in the history of the Cane Sugar Industry;

Achieves in one compact unit the aggregate results obtained by a separate crusher and a separate shredder of the best types, at materially less cost, and at greatly reduced power-consumption;

Produces shreds, the fineness of which can be easily regulated by adjusting the speed of the shredding roller.

(See inside of back-cover.)

The Sugar Machinery Mfg. Co., Ltd.,
76 Elsham Road,
London. W. 14.

Trade Notices.

The Dorr Clarifier, and the Petree Process. *Bulletins Nos. 3 and 4.* (Petree & Dorr, Inc., of New York ; Havana ; Honolulu ; San Juan, P. R. ; and Rio de Janeiro). 1925.

Bulletin No. 3.—The Dorr Clarifier, the principle of the operation of which is known to our readers, has been modified to adapt it to deal with sugar factory juices, and now forms a remarkably efficient means of eliminating mud with a low sucrose content. It is continuous in its action, giving a constant flow of uniformly bright juice of a clarity much superior to that furnished by the open-defecator system. Even when burnt and sour canes are being ground, the brightness of the juice is not diminished, though the capacity of the apparatus may be slightly reduced. This improved elimination of solids results in a clean syrup, an easy graining in the pans, and a better sugar than is ordinarily obtained. With most grades and conditions of cane, the mud withdrawn from the Dorr Clarifier carries only about 5 per cent. of the total juice, instead of the 10–20 per cent. in the mud usually discharged from defecators. In short, the advantages of this system compared with old style defecation is : A continuous flow of clean, bright juice, reduction of sugar loss in press-cake, hotter juices for evaporator feed, more efficient boiling house work, more rapid working up of juices, less filtering surface, reduced floor space, cleaner sugars, saving of labour, and saving of fuel.

Bulletin No. 4.—The Petree Process has achieved remarkable success in different parts of the world, and here its principle is explained, its mechanical equipment is described, and its advantages are summarized In addition to the Dorr Clarifier, apparatus which has now been introduced with considerable success into cane factories operating the process include the Petree "Duplex" Liming Machine, the Mud Distributor, and Flash Tanks. Wherever located, factories report that the Petree Process produces brighter and more satisfactory juice with or without sulphitation and at a greatly reduced operating cost. Dorr clarifiers ordinarily require the labour of one man per shift, and these take the place of the following machinery with its supplies, repairs and labour : Liming tanks ; open defecators ; scum tanks ; mechanical filters ; filter-presses and cloths ; clarified juice strainers or screens ; press-mud cars and track ; washing machines for cloth ; and pumps, engines, tanks, etc., used with above. In the case of a 1000-ton house, the positive savings are : in labour, about 15 men ; in fuel, the equivalent of about 1000 galls. of fuel oil per day ; in press-cloth, $10-20 per day ; and in sugar, between 1 and 2 per cent. additional recovery, calculated on the sucrose in the cane.

These two attractively illustrated Bulletins are obtainable on application to Petree & Dorr, Inc., and are of interest to every cane technologist.

Messrs. RANSOMES, SIMS & JEFFERIES, LTD., of Ipswich, make a speciality of Electrical Industrial Trucks, and a catalogue lately issued by them, consisting of some 36 pages, illustrates and describes fully the various types turned out by this firm. The illustrations largely consist of views of the machines at work in factories, storehouses, and engineering works. It is claimed that in most cases great economies may be effected by employing electrically operated trucks ; indeed experience has shown that one such truck will perform the work of six labourers. There is also offered an electric runabout crane which should prove useful for stacking sacks of sugar in storehouses ; this type has already found employment in the Liverpool and London dock warehouses for stacking purposes, while the electric trucks find a use in some of the sugar refineries in this country.

Besides its main output of hoists and derricks, the AMERICAN HOIST & DERRICK CO., of St. Paul, Minnesota, manufacture some effective electric shop appliances. Electric rivet heaters, electric ring and tire heaters, electric oil hoists, magnetic portable tool supports, electric bar welders, and waterproof magnetic chucks to hold castings while being machined, are instances ; and these may be found described in a Catalogue issued by this firm.

Brevities.

Among new companies recently registered in the United Kingdom are: Sankey Sugar Company, Ltd. (Reg. No. 208,260).—Private company. To adopt an agreement with the Sankey Sugar Company, Ltd. (incorporated in 1924) and its Liquidator. Nominal capital £500,000, in £1 shares.

One of the New York financial papers in the course of an article on the sugar refining situation makes the remark that: "in the last 10 years the American Sugar Refining Co., the largest refiner in the world, has sold over $2,100,000,000 worth of refined sugar at a profit of 2½ per cent. on sales, or less than one-fifth of a cent on each pound of sugar handled"

Referring to the list of Indian sugar-houses on page 580 of our October issue, we are asked to state that the United Provinces Sugar Co.'s Factory at Tumkohi, was designed, equipped and erected by the Sugar Machinery Manufacturing Company, Limited, of London (not by the Harvey Engineering Co., as stated). A short description of this Factory has appeared in this *Journal*[1].

Having stated in a previous article that the quantity of "Sumazine" blue necessary is considerable, Berthold Block[2] now corrects this. Actually the amount on the average is only 28 grms. per ton of sugar, and its cost is only a few pence per ton of sugar blued. It is not a pure blue, but a mixture of colours, calculated to produce the maximum whitening effect. It is much used in the production of plantation whites, being generally introduced in the pan, where it appears to be absorbed on the surface of the crystal.

The Second Conference of the Association of Special Libraries and Information Bureaux[3] was held recently at Balliol College, Oxford. Dr. Chalmers-Mitchell, F.R.S., uged the establishment in this country of a Central Library, in which a copy of every periodical which published scientific work should be available. Abstracting, was treated by Mr. T. F Burton, Editor of the Bureau of Chemical Abstracts (Chemical Society and Society of Chemical Industry), who discussed the preparation of abstracts, their limitations, the selection of abstractors, and also the question of overlapping in abstracts.

Under the auspices of the Royal Agricultural Society demonstrations of sugar beet lifting machines took place recently on the estate of Home Grown Sugar, Ltd., Kelham, near Newark. In the first class, for machines which top and lift the roots and separate them from the leaves and crowns, there was only one entry, made by Messrs. Townsend Brothers, Great Ponton, Grantham. In class 2, for machines which loosen the roots, leaving them to be subsequently lifted and topped by hand, six machines were entered, and the first prize was awarded to J. Cook & Sons, Ltd, Lincoln. A special prize was awarded to Fowler & Co., Leeds, for their cable lifter.

In an appreciation of the late Claude T. Berthon, A.M.I C.E., who died recently and was well-known in sugar circles in London as a consulting engineer, Mr. Algernon E Aspinall[4] remarks: "But the crowning work of his life was the factory at St Augustine (model factory of the Imperial College of Tropical Agriculture). Gratuitously and without any expectation of commendation or reward he designed the building and, what is more, carried on the negotiations which led to the gift by the British sugar machinery engineers of machinery for it to the value of fully £20,000. It is not too much to say that he was completely wrapped up in the factory, to the successful completion and equipment of which he devoted many months of study and careful thought. He watched it grow as if it were his child and no detail was too small to receive his attention; and it was one of the proudest days in his life when the cablegram was received stating that the factory had been opened and that the mill had successfully 'gone about.' Gifted with a charm of manner and a sympathetic personality Claude Berthon had many friends who will at least rejoice to know that he lived to see the fruition of his Imperial work, which would no doubt, in due course, have received the recognition in official quarters which it deserved."

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[1] *I.S.J.*, 1916, 79.

[2] *Die deutsche Zuckerindustrie*, 1925, 50, 43, 1414.

[3] See also *I.S.J.*, 1925, 490.

[4] *Tropical Agriculture*, 1925, 2, No. 10, 200.

Brevities.

Mr. A. J. V. **Underwood**[1] has compiled a series of nomographs, or alignment charts, for facilitating the calculation of various complicated formulæ, and these aids should be of much service to chemical engineers.

A recent official decree by the French Government provides that sugar, to be used for making porous absorbent charcoal, is to be freed from tax, provided it is denatured by ferric chloride, adding five per cent. on the weight of the sugar, the two substances being intimately mixed together.

In the production of decolorizing carbons in general a high temperature, one in the neighbourhood of 1000°C., is used. But W. **Mecklenburg**[2] points out that this is not absolutely necessary, and that one of the best-known carbons, "Carboraffin," is produced at a temperature of 500° C. only, after having been impregnated with a concentrated aqueous solution of zinc chloride. He adds that the production of active carbons demands an extraordinary amount of experience, and that it is one of the most difficult technical processes to operate of which he has knowledge.

Generally sulphiting tanks in German sugar factories are constructed of wrought-iron,[3] and but seldom of hard lead (lead containing antimony and other metals) or other resistant material. This material is used in spite of the known fact that wet SO_2 attacks iron, causing this metal to pass into the juice in the form of a compound causing a marked darkening, the result being such that sometimes the bleaching action of the sulphurous acid is undone by the result of this corrosive action. This is a question for investigation, to determine on the one hand the extent of the darkening from this cause, and on the other to discover the material best capable of resisting the action of the acid.

Monel metal is resistant to a greater variety of chemical reagents than any other commercial alloy on the market to-day. But not only is it resistant to corrosion, for it also combines great strength and withstands abrasion well. In almost every branch of chemical industry, it is now being used to great advantage, replacing other metals with great satisfaction. In both cane and beet sugar manufacture it is also being introduced; in the former branch particularly for juice strainers; in the latter for cold and hot saccharate work; and in both for valves, pumps, rods, and other parts ordinarily subject to corrosion. Monel metal is a uniform nickel-copper alloy (of high nickel content), which is mined, smelted, refined, rolled, and marketed by the International Nickel Company.

In an editorial headed "Quality Production," our excellent contemporary *Sugar News* remarks that a refinery can only work efficiently when its normal course is unaffected by being called upon to deal with low quality raws This low quality may mean not merely a low polarization, but may involve an unusually high amount of insoluble and colloidal matter left by imperfect clarification during production. Few centrals (in the P. I.) if any, have an adequate settling capacity to yield a perfect clarification when running at full capacity. Fortunately it is not necessary in this case to reply to the old fallacious argument that "it doesn't pay to give any more than we are paid for," since experience has proved that those factories which have improved their clarification and are making a better refining sugar are having less trouble in their own boiling houses and are actually getting an increased recovery of sugar.

In America the packing of sugar in cartons (a practice that is adopted for most of the other purchases of the housewife) is being advocated, especially in the case of domestic beet sugar. It is pointed out that the consumer gains by purchasing her sugars thus, as not only is the standard of quality kept uniform, but perfect cleanliness is ensured. Then the refiner or the beet sugar manufacturer also gains, as he markets a standard-grade product under a trade name, which, as the result of advertising, acquires a certain reputation, thus developing an important proprietary, which becomes identified with his own name, becoming a household word. He also induces the housewife to purchase different kinds of sugars: lump for tea and coffee; granulated for cooking, baking, and sweet-making; powdered for fruits and iced drinks; icing for confectionery, and so on. Moreover, the grocer is able to display his sugar wares, and trade in this commodity must thus to some extent be stimulated.[4]

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[1] *Chemical Trade Journal*, 1925, 77, No. 2000, 320 and 325.

[2] *Zeitsch. für angew. Chemie*, 1924, 37, No. 45, 873.

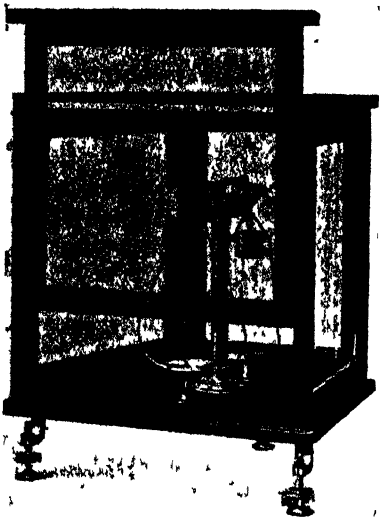
[3] *Centr. Zuckerind.*, 1925, 33, No. 37, 1200.

[4] *Sugar Beet Journal*, October, 1925, page 17.

Review of Current Technical Literature.[1]

"RAPID" BALANCE FOR WEIGHING SAMPLES OF SUGARS FOR POLARIZATIONS. *Communication to this Journal by the Suppliers of the Apparatus.*

An ordinary analytical balance is not well adapted for rapidly weighing out a large number of quantities of samples, say 52·0, 26·0 or 13·0 grms., for determining the polarization of sugar. It may have a sufficient sensitiveness, but has not the requisite rapidity. In the illustration is shown a specially devised balance particularly well suited for this purpose, which, in fact, has been specially devised for it. An accuracy of only about 0·013 grm. is required in weighing for polarizations when the saccharimeter is read say to 0·05°S., and indeed it is undesirable to exceed this accuracy when using the ordinary analytical balance, as the extra time involved gives opportunity for some loss of moisture in the sample exposed to the air. On examining the illustration, it is at once seen that its arrangement differs from that of an ordinary balance. Instead of having two arms of equal length, balanced in the centre, its two arms differ considerably in length, the ratio of one to the other being as 1 is to 10. It is the longer arm that carries the pan that holds the counterpoised dish into which the sugar is weighed, whilst the other holds a metal box into which small shot for counterpoising is placed. Further, it will be seen that the position of the balance in the case differs from the ordinary, the arrangement being adapted for speed in manipulation. It has glass side doors, and a counterpoised sliding front; whilst other details of the construction of the instrument are that its beams are of magnalium, the knife edges of diamond steel, the bearings of agate, and the beam and pan supports are capable of being released or arrested at will during operations. In weighing out the series of normal weight quantities, the counterpoised dish is placed on the front pan, accurately tared by placing shot in the metal box and weights on the rear one, the 26·0 grm. weight placed on the rear pan, and the sugar weighed into the dish, sufficient being added to just bring the pointer to the zero mark of the scale, which can be done with great rapidity with very little practice. One user testifies regarding this balance that "the accuracy is fully adequate, and the speed remarkable."



COMPARATIVE VALUE OF DECOLORIZING CARBON ("SUCHAR") AND ANIMAL CHARCOAL. *Leonard Wickenden. Chemistry and Industry, 1925, 44, No. 44, 1075.*

Mr. FARNELL has stated[2] that "the actual decolorization obtained with bone-char is as good as, if not better than, that obtained with carbons, unless a prohibitive amount of the latter be employed"; but the obvious reply to this is that it depends (1) on the vegetable carbon, and (2) on what is considered a prohibitive amount. At Southdown Refinery, Houma, La., it was found possible by mixing the melt with only 1 per cent. of "Suchar" on the solids to boil to white sugar, the liquors being almost perfectly decolorized. Five strikes of granulated were obtained in this refinery, and this sugar competed with bone-char sugar. being in fact generally conceded to be superior in colour and brilliance. In 1924-25 the amount was reduced to 0·7 per cent., and with equally satisfactory results. It was revivified completely with only small mechanical and ignition losses, and the actual carbon consumed amounted to less than 1 lb. per ton of raw melted. Another criticism made by Mr. **Farnell**[1] is that the removal of ash by bone-char is more than by carbons. But, it is universally conceded that much of this ash is again liberated when "sweetening off" and re-introduced with the concentrated sweet-waters. Therefore, the actual practical facts are: (1) That the yield of granulated sugar obtained in the "Suchar" process is slightly higher than by bone-char (the molasses being correspondingly lower); (2) that the sugar is at least as attractive; (3) that it keeps indefinitely; and (4) that it is not higher in ash. Mr. **Farnell** wrote[2] that "the manufacture of activated carbons is one thing, and their application quite another," and with this the author heartily agrees. It is true in its theoretical as well as in its practical aspect. If the profound truth of this statement had been more generally realized, much disappointment would have been avoided, and many of the criticisms levelled at vegetable carbons would never have been made.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] *Chemistry and Industry*, 1925, 44, No, 36, 892.

IMPERIAL COLLEGE OF TROPICAL AGRICULTURE: CONTROL RESULTS OF THE COLLEGE FACTORY FOR THE 1925 CROP. O. F. Boyd. *Journal of the Imperial College of Tropical Agriculture, 1925, 2, No. 8, 172.*

Prof. **Boyd** reports that the Experimental Factory of the Imperial College succeeded in completing its first crop satisfactorily and successfully. Canes from the Government Farm of a very good purity and sucrose content were ground, the principal type of sugar made being grey crystals, although a small amount of yellow crystals was also produced. A fair idea of the work accomplished is given by the following figures:—

Grinding days	74·0
Cane ground, tons	2,606·382
Sugar made, tons	246·343
Tons of cane per ton of sugar	10·5
Yield of sugar, per cent. on cane	9·451
Sucrose in cane per crop, average	12·688
Fibre ,, ,, ,,	13·251
Crushing figure, average	74·661
Syrup purity ,,	84 18
Final molasses, purity	34·95
Normal juice, ,,	80·02
Lime, lbs. per ton of cane	1·9
Sulphur, lbs. per ton of cane	0·57
Fuel oil, gallons per ton of cane	7·29
Final molasses, gallons per ton of cane (including first molasses sent outside)	8·74

APPARATUS FOR THE MEASUREMENT OF COLOUR AND THE INDICATION OF THE DEGREE OF WHITENESS (*A*) *Communicated by Kodak, Ltd., Wratten Division, Kingsway, London, W.C. 2* (*B*) W. E. Schopen. *West Export (Technische Beilage zur Rheinisch-Westfalischen Wirtschaftszeitung), September 15th, 1925*

(*A*) This "Eastman" instrument is designed for use in the factory or laboratory where the measurement, comparison, or standardization of colours is required. It is particularly adapted to the measurement of colours of sugars, fabrics, paper, oils, paints, inks, dyes and dyed materials, coloured glass or celluloid, food or dairy products, and the like. It operates on the subtractive principle. Light from the sample is made to illuminate one half of the field of view in the eye-piece; the other half of the field is illuminated from a standard lamp by light which has been passed through dyed gelatine wedges, which consist of thin layers of gelatine of increasing thickness from zero to a maximum. The gelatine contains a dye which will absorb, in varying amounts, one of the additive 3-colour primaries. There are three of the coloured wedges; and, by changing their positions, any desired amount of each of the colour primaries may be subtracted from the white light. By using only two of the coloured wedges at a time, with a neutral grey wedge to match the brightness of the colour, it is possible to match every tint or shade of every colour including the non-spectral colours, purple or magenta. Then the colour in them is recorded by reading on the scale of the instrument the position of the wedges necessary to produce the colour match. For every colour there is one and only one setting of the wedges which will produce a colour match Unless calibrated, therefore, the scale on the Eastman "Universal" colorimeter reads in arbitrary units of colour, based on a decimal notation, the most saturated colour being given by the reading of 100. It is often found necessary to measure the colour of materials which have a colour differing only very slightly from the white, and for this purpose a tint intensifier is provided. This is an attachment which fits over the end of the telescope tubes and makes possible the measurement of the colour of off-colour sugars, tinted paper, fabrics, etc. It utilizes the principle of multiple reflections and intensifies the colour so that tints which are scarcely distinguishable from pure white are easily measured on the colorimeter. Manipulation of this apparatus is so simple that an unexperienced observer can learn with a little practice to make satisfactory measurements.

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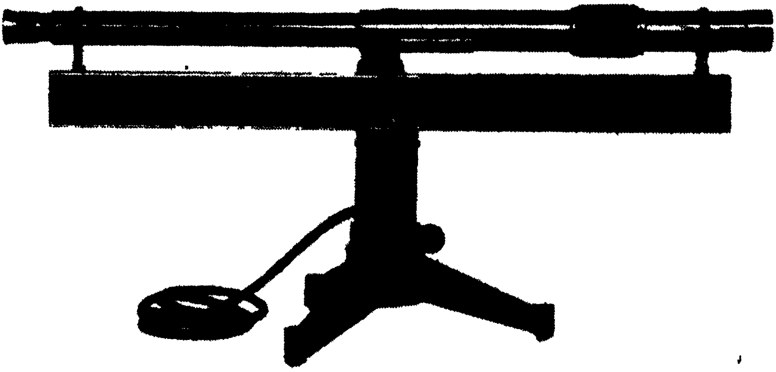
[1] *Loc. cit.*

[2] *Loc. cit.*



Eastman 'Universal" Colorimeter

(*B*) Two other types of instruments may be mentioned more briefly. One, the "Universal" half-shadow photometer, invented by **Wilhelm Ostwald**, the application of which has been described by **Douglas**.[1] It is also termed a "glossimeter," that is a device for indicating the "degree of whiteness" of a wide variety of white, or off-white substances, such as unrefined sugars, produce (as flours, rices, sagos, barleys, etc.), paper, cloth (especially artificial silk), mineral substances, chemicals, pharmaceutical preparations, and the like. The other, the "Ingersoll" photometer, which has been found of particular interest in the paper trade for indicating and recording the whiteness of samples. It has been described by **R. E. Lofton**[2]

Use of Ultra-Violet Light for Judging the Quality of Commercial Sugar Products.

Harald Lundén.[3] *Centralblatt fur die Zuckerindustrie, 1925, 33, No. 40, 1281-1282*

Judging the quality of a sugar (in respect of its colour) is not easy in daylight. Observations of the appearance of sugar products are best carried out in violet or blue light. Pure sugar (say, one having an ash content less than 0·003 per cent.) reflects direct light without selective absorption and without fluorescence, whilst in light from the mercury vapour lamp it appears dark violet. On mixing in coloured non-fluorescent substances its colour is made darker. Raw sugars fluoresce in yellowish light; less coloured sugars (e g., "melis" with an ash content of about 0·01 per cent) appears almost white; and still better sugar is almost violet, and the more so, the purer it is. Hence, by mixing products with known amounts of impurities, one can obtain a series of samples of progressive colour-content, these representing a scale which serves excellently for the estimation of the quality so far as its "whiteness" is concerned. This method is very sensitive, being capable of easily distinguishing grades corresponding to 0·001 per cent. of ash, the distinction between so-called "white sugar" (affined raw sugar having 0·05 per cent. of ash), for example, and "melis" having 0·01 per cent., is very distinct. Pure solutions of sugar absorb ultra-violet rays only slightly, but coloured ones do so to a very great extent. Even moderately coloured solutions show a strong yellow fluorescence, and slightly coloured ones appear dim, in which way extremely small amounts of colour can be detected. Solutions that on observation in violet light cannot be distinguished from water, appear cloudy in ultra-violet light. On dissolving 50 grm portions of different sugars in 100 c c. of water, and examining these solutions in ultra-violet light, refined having an ash content of 0·007 per cent. appeared rather dim; "melis" with an ash content of 0·01 per cent. was somewhat cloudy, whilst affined raw sugar with an ash of 0·07 per cent. exhibited a yellow fluorescence.

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[1] *Melliand's Textil-berichte*, 1921, 411. [2] *Paper Trade Journal*, 1924, 7, 55.

[3] Contribution from the Laboratory of the Svenska Sockerfabriks, A. B., Gothenburg, Sweden.

THEORY OF THE EFFECT OF ACTIVE (DECOLORIZING) CARBONS. *Otto Ruff.* *Chemiker Zeitung, September 10th, 1925;* through *Chemical Trade Journal, 1925, 77, No. 2000, 323.*

Activation (it is thought) consists in the "etching" with such suitable reagents as carbon monoxide or water vapour which remove or modify part of the surface of the carbon Activated carbons are usually made by the carbonization of organic materials in the presence of a suitable inorganic medium. The first hypothesis to account for the activation of a carbon, and the general criterion of all active carbons is their amorphous condition, but in the surface layers of such amorphous carbons a number of the carbon atoms are in the unsaturated condition, that is, they possess one free valency. In the case of those carbons of the highest activity and adsorptive power, the proportion of unsaturated to saturated carbon atoms is as one to twelve. Active and inactive carbon atoms together enclose in layers of about three atoms thick, small ultra microscopic cavities ("atom gaps"). There are in addition cavities of large size, microscopic and macroscopic. In the case of inactive carbons, the superficial atom layers are constituted entirely of saturated carbon atoms Removal of this inactive layer is the purpose of the activation process. Prof. RUFF was led to the above conclusions as the result of a long series of investigations on the structure of carbons as revealed by X-ray analysis. He mentions that cases are known of carbons which have not been subjected to any definite activation process, but which nevertheless are found to be active.

SOME PRACTICAL SUGGESTIONS ON THE OPERATION OF FILTER-PRESSES. *Esterban A. Alcazar.* *Sugar News, 1925, 6, No. 7, 401-2.*

Instead of running the press juice directly to the clarified juice tank, the author proposes at Ma-ao factory, P.I., to provide separate tanks—one for the press-juice and one to receive the hot water used in washing the mud and the cloths. This second tank is to prevent the cleansing water from dropping on the mud cake from the presses, or from diluting the mud in the mud tank too far, as if the latter were to happen it would unduly increase the work of the presses. It is not desirable to allow the cleansing water to run down with the press-cake because its fertilizing value would be lessened, and its handling made more difficult. On the other hand, the cleansing water stored in a separate tank as proposed can be used repeatedly, a pump being provided for that purpose. In the writer's opinion, the practice of running the press-juice directly to the clarified juice tank is inadvisable, in the first place because the press-juice may be and often is overlimed; and, in addition to changes in the reaction of the clarified juice that it may induce, more soluble salts of calcium than would otherwise be present would be added to the juice going to the evaporators, thus increasing unnecessarily the scale in them. Then there is the danger of dirty juice from the filter-press finding its way to the clarified juice tank, through the oversight or negligence of operators. In washing, the first portion of the water is run to the press-juice tank and reclarified together with the filter-press juice, before dropping to the clarified juice tank; while the next portion is used in diluting the mud previous to passing it through the filter-press, and the last portion is stored in the tank provided for that purpose as recommended.

Fire Underwriters' Regulations for Sugar Pulverizing Plant. *Anon.* *Sugar, 1925, 27, No. 8, 389-390.* Conditions are stated for location, construction, communications, power, lighting, wiring, etc., and a list of preventive measures is given.—Wave Length Factors Involved in the Spectrometric Analysis of Technical Sugar Products. *H. H. Peters and F. P. Phelps.* *Sugar, 1925, 27, No. 7, 333.* This gives supplementary data to those recently reported by these authors.[1]—Construction of Laboratory Vacuum Pan and Crystallizer. *F. W. Reynolds.* *La. Planter, 1924, 72, No. 19, 369-370.* Body of the pan is 8 in. × 18 in., the coil being of copper tubing, $\frac{1}{4}$ in. diam., the features of the apparatus being "visibility of the operation and control of conditions." Crystallizer consists of a jacketted cylinder, which is provided with a stirring arrangement. Apparatus is mounted on a stand that can be run under the pan to receive the charge, whilst in a tilted position.—Products of the Hydrolysis of Starch. *Henry Berlin.* *Paper presented to the Division of Sugar Chemistry, American Chemical Society, Los Angeles, Cal., August, 1925.* Two disaccharides, both isomeric with maltose, but neither fermentable with bakers' yeast were found, data being given to prove that one of these resembles isomaltose, as prepared from pure dextrose by Fischer, Harrison and Ost.—Structural Formula of Glucose. *W. N. Haworth.* *Nature*, September 19th, 1925. New evidence obtained in the Laboratories of Armstrong College shows that the oxide ring placed in the butylene-oxydic or 1 : 4 position in the γ-oxide ring formula is displaced, the attachment being that of a 6-membered ring, i.e., a 1 : 5 or amylene oxide.—Blueing of Sugar Crystals, using Ultramarine, Indanthrene, and Sumazine. *Berthold Block.* *Die deutsch Zuckerindustrie, 1925, 50, No. 39, 1301-1303.* Ultramarine may not be fast to influences of atmosphere and light, and sugar treated with it may be the cause of complaints by makers of condensed milk, liquors, and fruit drinks. Blues may be used to advantage in the pan; and, when ultramarine is so employed, it does not crystallize in the grain, whereas other preparations do, a better effect being thus obtained. When used at the centrifugals, the result may be less satisfactory, though devices such as those described by Henry Baker,[2] C. W. Julius Blancke & Co.,[3] Hruska,[4] and G. Deutsch[5] have been designed to overcome this difficulty.—Dust Explosions in Industrial Plants. *Hylton R. Brown* *Industrial and Engineering Chemistry, 1925, 17, No. 9. 902-904.* A general article on the subject, in which the principles stated by Beyersdorfer[6] are stated.—Lactose: a Review. *E. O. Whittier.* *Chemical Reviews, 1925, 2, No. 1, 85-125* Headings on this article are: historical, sources, biosynthesis, distinguishing tests, determination, hydrolysis, utilization, bacteriological, oxidation and hydrogenation, effects of heat, derivatives, structure, physical data, and references.—Polarization of Beet Molasses using Basic Lead Acetate and Alkaline Lead Nitrate for Clarification. *Rudolf Ofner.* *Zeitsch. Zuckerind. Czechoslov., 1925, 50, No. 5, 38-39.* Results obtained during last season are now given demonstrating that the former reagent gives polarizations which may be 0·5°V. higher than when the latter is used, but average about 0·2°V. This is a lower difference than previously reported.[7]—Manufacture of Pectin, using Beet Pulp, etc. *C. P. Wilson.* *Ind. Eng. Chem., 1925, 17, No. 10, 1065-1067.* Several products may be used as raw material, but only the residue from apples or citrus fruits have been used commercially so far. Beet pulp contains 25-30 per cent. of pectin (of dry matter). A brief review of the general and patent literature is given, with a discussion of the principles utilized; and a bibliography of 30 papers and patents is appended.

J. P. O.

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[1] *I.S.J.*, 1925, 447. [2] German Patent, 90,124 of 1897. [3] German Patent, 43,460 of 1887. [4] German Patent, 112,894 of 1899. [5] *Chem App.*, 1925, 45. [6] *I.S.J*, 1922, 573, 363. [7] *I.S.J.*, 1925, 509.

Review of Recent Patents.[1]

UNITED STATES.

Centrifugal Machine Installation. *Maurice C. Meikle* (assignor to *William Washington*, of New Orleans, La., U.S.A.). *1,540,646.* June 2nd, 1926.

A centrifugal machine installation is provided such that it is possible to connect up a battery of unit machines in a way permitting a single operator loading the lot in one operation. A discharging device, greatly facilitating the emptying of the machines; and a brake mechanism for retarding the drive shaft of the basket, are likewise provided. Referring to the drawings (Figs. 1 and 2 being plan and side elevation of the battery installation, and Fig. 3 a sectional view through the improved unit machine), *1* is a trough containing raw sugar extending over the battery of machines, its bottom being provided with a plurality of chutes *2* which extend down to a series of tanks *3*, and where the chutes *2* connect with the tanks *3*, openings *4* are provided. A slide *5*, mounted in guides between all of the chutes and the several tanks *3*, has a plurality of valves *7* corresponding in location to the location of the chutes. These valves *7* have openings *8*, which, when the slide is shifted in one direction, register with the openings *4*, to permit the raw sugar (massecuite) from the trough *1* to enter the tanks *3* simultaneously. In this way the work of filling the tanks is greatly facilitated, and can be accomplished by a single operator in one operation. To this end a shaft *9* is mounted in bearings *10* and *11*, the former being carried by the casing of the centrifugal machine, while the latter are carried by the tanks *3*. It is provided with a gear or pinion *12* meshing with teeth on the slide *5*, so that when the shaft is rotated the slide is reciprocated, and the openings therein simultaneously caused to register with the openings *4* of the tanks *3*, allowing the raw sugar to pass from the trough *1* into all of the tanks at one time. A hand-wheel *13* is carried by the shaft *9*, whereby the shaft may be rotated. Each of the tanks *3* is provided with a glass or other transparent covered observation opening. Mounted in suitable guides *14* at the inter-section of the chutes or spouts *15* with the tanks is a slide *16* also with a plurality of valves *17* having openings *18* adapted to register with the chutes or

Fig. 1.

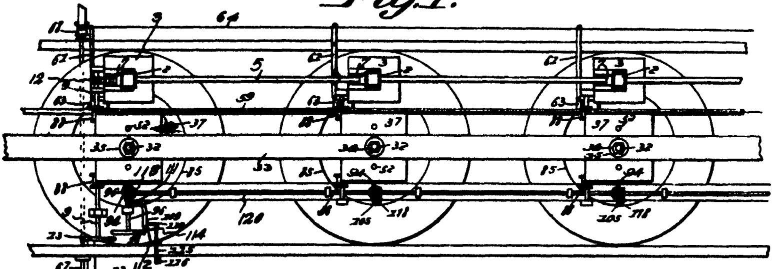
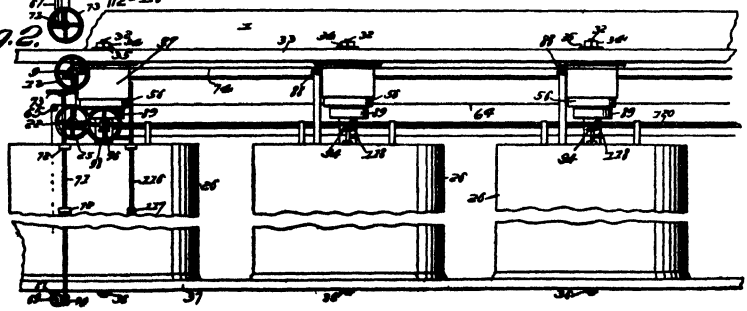


Fig. 2.



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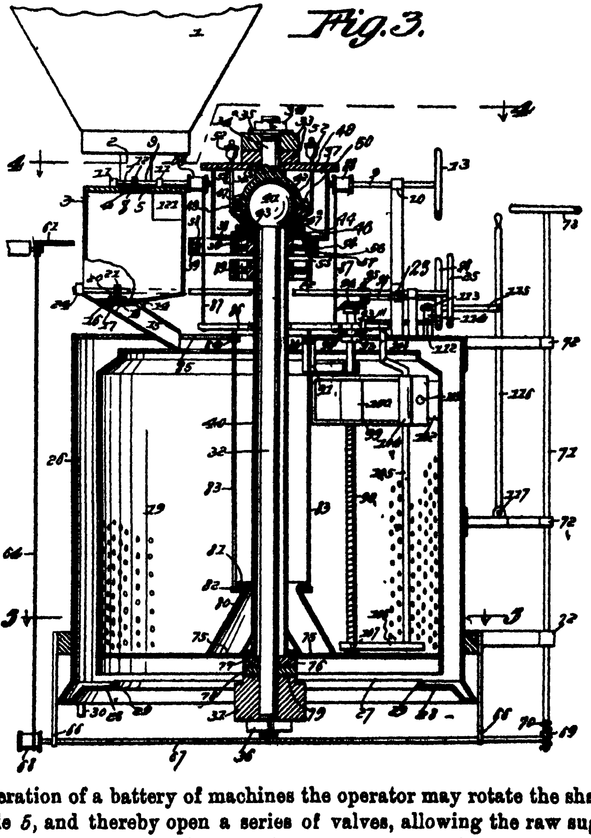
[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price, 1s. each). *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris. *Germany:* Patentamt, Berlin, Germany.

spouts *15*, to permit the sugar from the tanks *3* to pass through the chutes or spouts, and into the corresponding centrifugal baskets *19*. Slide *16* is provided with rack teeth *20*, engaged by the pinion *21*, which is mounted upon a shaft *22*. This shaft *22* is mounted in bearings *23* and *24*, and is provided with a hand-wheel *25*, whereby the slide *16* may be adjusted. Each machine comprises a stationary casing *26*, the bottom of which is open as shown at *27* to permit the sugar being discharged from the centrifugal basket *19*. In detail the lower portion of the wall of the casing *26* is outwardly turned, and then inwardly and upwardly turned terminating in a flange *28*. The upturned margin *29* of the flange *28* is provided for the purpose of preventing the syrup from overflowing as it enters the channel formed by the flange as the centrifugal basket rotates. The syrup is allowed to pass off through the pipe *30*, which may be provided with a valve (not shown) for the purpose of controlling the flow.

Fig. 3.



In the operation of a battery of machines the operator may rotate the shaft *9*, operate the upper slide *5*, and thereby open a series of valves, allowing the raw sugar from the trough *1* to enter the series of tanks *3*. After the tanks *3* are filled, power may be transmitted to the centrifugal baskets *19*, and as soon as they receive movement, the shaft *22* may be rotated, imparting longitudinal movement to the slide *16*, thereby opening all of the lower valves of the several tanks *3*, allowing the raw sugar in the tanks to enter the centrifugal baskets simultaneously. Then the lower valves are closed, and the centrifugal baskets rotate causing the solution to deposit upon the perforated walls of the baskets *19*, the syrup draining off into the channel at the lower part of the casing *26*. When the sugar becomes thoroughly dried and refined, the baskets are stopped; but while the baskets are still rotating the scraper is swung into a lateral position on screw *90* which acts as a fulcrum, with the scraping edges of scrapers *102* out of contact with the walls of the baskets. Just as soon as the baskets are stopped, the operator manipulates lever *116* to mover scraper *102* so that its edge will engage or dig into the sugar on the inner surface of the basket of possibly the first machine The basket of the first machine is again rotated, and the dried and the refined sugar is scraped from the wall of the basket. While this is being accomplished, the operator every so often imparts movement to wheel *98* which in turn will operate shaft *96*, and thereby rotate screw *90*, causing the scraper holder to gradually descend, until the entire inner surface of the cylindrical wall of the casing is scraped of the deposits of sugar. While the centrifugals are being scraped out the shaft *9* is rotated, so as to again operate the upper slide and open the upper valves, filling the tanks *3*. When the shaft *9* is rotated, it winds up the cables *87*, which lift up the ring *86* and the ring *82*, thereby lifting the cover *80*, uncovering the diametrically opposite openings *75*. While the openings *75* are uncovered and the scraping process is being accomplished, strip *106* tends to feed the sugar toward the centre so that it can discharge through the openings, where it may be deposited in any suitable receptacle. When the shaft *9* is rotated in the opposite direction so as to close the upper valves, cover *80* will be lowered to again close opening *75*. Then the lower valves are opened by operating the shaft *22*, and each of the baskets receives its charge from the corresponding tank *3*. It will be seen that with this construction there is a simultaneous discharge of sugar from the trough *1* into each of the tanks *3* while the several centrifugals are being cleaned or discharged, and that the act of lowering cover *80* operates the valves which control the discharge of sugar from the trough *1* into the tank *3*. This gives each tank *3* its proper charge of crude sugar, and then by opening all of the valves controlling the flow of sugar from the tanks to the centrifugals, the sugar will flow from the several tanks into the centrifugals at one time All of the machines may be retarded at one time to receive the sugar from the several tanks; all the tanks *3* may be filled at one time while the centrifugals are being operated; and all the machines may be cleaned at one time. Thus one operator can attend to a plurality of machines with no more trouble than at the present time an operator can attend to one machine. It will likewise be noted that the suspension means provided for each centrifugal is such as will permit the baskets swinging so as to compensate for a greater load on one side of the basket than is on the other. While the scraping process may be conducted on each machine separately, it may be accomplished on all of the machines simultaneously. Means for accomplishing this consist of bevel gears *118* upon shaft *120*, said gears being in turn in mesh with bevel gears *94* which actuate screw shafts *90* of the several tanks, whereby, when the shaft *96* is rotated by hand-wheel *98*, all the scrapers will be fed downwardly.

DECOLORIZATION OF SUGAR JUICES, SYRUPS, REFINERY LIQUORS, ETC., USING DYE-MORDANTS. *John C. Hebden*, of New York City, N.Y., U.S.A. *1,545,318*. July 7th, 1925.

This invention is described as being based on the discovery that the colouring matters in the juices, syrups, etc, belong to two distinct classes of dyestuffs, i.e., to the basics dyes and to the mordant-dyeing colouring matters; and it comprehends the employmen- of substances which act as mordants to combine chemically with these dyestuffs, thut removing them. Further, these mordants possess the property of combining with the waxes or fatty matters contained in juices, syrups, etc., as well as with the gums and with the protein or albuminous substance. It is thus possible to remove 60 per cent. or more of the total colour, to remove the major part of the gums and the proteins or albuminous substances, and to remove practically all of the waxes or fatty matters, so that only small amounts of the usual clarifiers or decolorizers need be used. Juice syrup or liquors thus produced are brilliant and water-white and freer from gum and similar substances, as compared with products obtained by present methods. In removing the colouring matters which may be tannin-like bodies of polyphenols or similar bodies, hydroxides of any of the metals which form insoluble compounds with tannic acid can be used. In view of their ease of preparation and also because their compounds are non-poisonous, it is preferable to employ the hydroxides of iron, alumina and titanium, which, in fact, have been found to be particularly serviceable. The efficiency of the process is however, greatly increased, if these agents are prepared on a substrate. A greater surface for contact is obtained, and a smaller or less percentage of mordant is required for the removal of the colouring matter and other impurities. Substances suitable as substrates are fuller's earth, kaolin or china clay, ground silica, dry alumina hydrate of the variety insoluble in water, kieselguhr or infusorial earth, ground wood or wood flour and any other finely divided substance which is insoluble in water and upon which the mordant can be precipitated.

As examples of the methods which may be employed the following will serve: To prepare the substrate one suspends in water infusorial earth, fuller's earth or other insoluble substance in quantity equal to say 2½ per cent. of the sugar to be treated. Then is added to this suspension sufficient sulphate of alumina to precipitate on the substrate say ½ to 1 per cent. of the weight of the sugar to be treated of aluminum hydroxide. The precipitation is performed preferably hot by sodium carbonate or any alkali which will transpose aluminium sulphate and precipitate the hydroxide leaving a soluble sulphate. The compounds formed upon the substrate are thoroughly washed with boiling water; they are then prepared as a cake containing, for example, from 60 to 70 per cent. of water, or they may be dried, if desired. The prepared substrate is added to the juice or syrup, which is thoroughly stirred to cause the compounds to mix therewith and the mixture is allowed to react for about one-half hour at a temperature preferably of from 100 to 120°F. A syrup for example thus treated, as compared with one untreated will filter at least 100 times faster, it will have 60 per cent. less colour, and it will have a brilliancy which is not possessed by the product obtainable by the method generally practised in sugar refining.

CLARIFICATION OF CANE JUICE, INVOLVING NEUTRALIZATION WITH INSOLUBLE COMPOUNDS, INCAPABLE OF ADVERSELY AFFECTING ITS CONSTITUENTS. *John C. Hebden*, of New York City, N.Y., U.S.A. *1,545,319.* July 7th, 1925.

A summary of this specification mainly in the wording of the original is as follows:—Instead of liming the juice, as is customary it is submitted to a first neutralizing operation, the purpose of which is to neutralize those acids in the juice which are stronger than carbonic acid, such as acetic, lactic, etc. This operation may consist in treating the juice with the salt of an acid weaker than carbonic acid or with a carbonate, but a carbonate insoluble in the juice, as calcium carbonate, or any water-soluble or water-insoluble soap, or trisodium phosphate "or a similar compound," may be used. By this treatment, the reagent used reacts specifically on those acids which are stronger than carbonic acid but does not react on the sugars or on other constituents of the juice. Next those acids in the juice are neutralized which are weaker than carbonic acid and similar substances such as the polyphenols, tannin bodies, glucosides and amido-acids, and some amphoteric bodies which react either as acids or bases. This neutralizing treatment is effected preferably by submitting the juice which is now slightly acid in reaction, to the action of certain water-insoluble reagents which react specifically on the relatively weaker acids, which reagents preferably are carried by a water insoluble substrate upon which the precipitates resulting from the reaction by which they are produced collect. Bagasse preferably is employed as a substrate in view not only of its availability, insolubility in water and other properties, but because of the facility with which it may be filtered or otherwise separated from the juice. The substrate is preferably prepared by precipitating on finely ground bagasse suspended in water, the water insoluble reagent or reagents in amount sufficient to neutralize the relatively weaker acids in the juice to the neutral point using litmus as an indicator. As to the reagents for neutralizing the acids weaker than carbonic, the inventor has found that any of those recommended in his prior patent[1] involving the principle of dye-mordanting, may be used; and the method of treatment there specified is here also applied.

CENTRIFUGAL MACHINES. (*A*) *Chas. A. Olcott* (assignor to *The S.S. Hepworth Co.*, of New York, U.S.A.). *1,536,915.* May 5th, 1925. (*B*) *Vincenzo Verney*, of Rome, Italy. *1,542,747.* June 16th, 1925.

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[1] U.S.P., 1,545,318.

Production, Application, and Revivification of Active (Decolorizing) Carbon. (*A*) ***Leonard Wickenden*** (assignor to the ***Industrial Chemical Company***), of New York, U.S.A. *1,535,797*. April 28th, 1925. (*B*) ***Oscar L. Barnebey***, Detroit, Mich., U.S.A. *1,537,286*. May 12th, 1925 (*C*) ***J. N. A. Sauer*** (assignor to the ***N.V. Norit Witsuiker Mij***), of Amsterdam, Holland. *1,542,006*. June 16th, 1925. (*D*) ***Christian J. Gambel***, of New Orleans, La., U.S.A. *1,543,763*. (*E*) ***Emil Hene***, of Strassfurt, Germany. *1,547,037*. July 21st, 1925.

(*A*) Claim is made for the process of increasing the decolorizing power of porous, carbonized material, which comprises boiling it in an aqueous solution of manganese sulphate and effecting adsorption of the metallic radicle thereof, and calcining the impregnated material at a temperature of about 800-900° C. in the presence of carbon dioxide to effect the limited oxidation of said carbonized material and greatly increase its decolorizing power without undesirable loss thereof. (*B*) A process of manufacturing decolorizing carbon is described in which carbonaceous silicon-containing material is charred, and the silica removed by reaction with fluo-silicic acid. (*C*) Claim is made for a medicinal preparation comprising a shaped product of a size adapted to be taken in the mouth, containing sterilized decolorizing vegetable carbon, substantially free from soluble ash constituents of which the dry matter contains substantially above 94 per cent. of free carbon, such material being held together by a crystalline binder which is readily soluble on the juices of the alimentary canal. (*D*) A decolorizing carbon is made by charring fibrous rice material containing silica, heating the charred material with an alkali to remove the resins present and a substantial proportion of said silica; removing substantially all the alkali from the charred material, treating the alkali left in the carbon with an acid anhydride having a b.p. below 212° F., and removing the latter from the carbon thus produced. (*E*) A method of making decolorizing carbon comprises mixing porous mineral coal with an alkali metal sulphur compound reducible to an alkali metal sulphide on heating with carbonaceous matter, heating the mixture at a temperature of at least 600° C., and subsequently dissolving out the alkali metal compounds from the carbon.

Carbohydrate Production from Vegetable Matter (for Alcohol Manufacture). ***Erik Hägglund*** (assignor to ***Th. Goldschmidt A.-G.***, of Essen, Germany). *1,544,149*. June 30th, 1925.

Cellulose vegetable matter is reacted upon with a solution of hydrochloric acid (containing not less than 39 per cent. by weight of HCl), the resulting solution of carbohydrate separated from the residue (which is leached with the 39 per cent. hydrochloric acid), hydrochloric acid gas dissolved in the resulting leach liquor, and this solution used for reacting upon a further quantity of cellulose vegetable matter.

Production of Fibre Boards [as "Celotex," from Bagasse, etc.].[1] ***John K. Shaw*** (assignor to ***C. F. Dahlberg***, of St. Paul, Minnesota, U.S.A.). *1,532,083*. March 31st, 1925.

This invention relates to a process of and apparatus for interlacing fibres, preparatory to making fibre boards. Claim is made for the process of making a fibre board of different kinds of fibres interlaced with each other, which consists in floating one set of fibres from a restricted passage into a relatively larger chamber, and transversely of the line of travel of, and on to a travelling foraminous surface; floating a second set of fibres on to said first mentioned fibres while the latter are in motion; floating a third set of fibres on to a second travelling foraminous surface; floating other fibres on to said third set of fibres while the latter are in motion; and compacting all of said fibres into the desired board, substantially as described. Claim is also made for a machine comprising the combination of an endless belt foraminous surface; a second endless belt foraminous surface; chambers adapted to float fibres to said surfaces; means to prevent the fibres in one chamber from mixing with the fibres in the adjoining chamber; means for exerting different hydrostatic pressures in said chambers; means for feeding fibres to said chambers; and means causing said surfaces to compact the mass of fibres fed thereto, substantially as described in this specification.

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[1] See also *I.S.J.*, 1924, 620; 1925, 60, 453.

CANE MILL OR CRUSHER. *Roberto T. E. Okrassa*, of Antigua, Guatemala, Central America. *1,539,502*. May 26th, 1925.

Claim 4: A cane crushing apparatus comprising a fixed crushing roller, a pair of movable crushing rollers co-acting with the fixed crushing rollers, each of the movable crushing rollers having a shaft extending therefrom, eccentric members mounted on said shafts, a bearing block for each of said eccentric members, a pair of levers for each of said movable rollers, means for clamping the eccentrics to the respective levers so that when the levers are swung back and forth the eccentrics will be rotated and the movable rollers will be moved substantially toward and from each other, a pulley carried by each of said levers near the upper end, a chain secured to one of the levers and reeved over said pulleys, and a weight acting on said chain for pulling the same so as to give the levers a tendency to move towards each other and consequently swing said movable rollers toward each other.

BEET TOPPERS. (*A*) *Jas. A. Harwood*, of Wheatland, Wyo., U.S.A. *1,536,492*. May 5th, 1925. (*B*) *John Scholl and John Weiler*, of Belgium, Wis., U.S A. *1,537,707*. May 12th, 1925. (*C*) *John Scholl and John Weiler*, of Belgium, Wis., U S.A. *1,539,874*. June 2nd, 1925. (*D*) *John W. Little*, of McCook, Nebr., U.S.A *1,541,158*. June 9th, 1925. (*E*) *Charles Vacek*, of Chicago, Ill., U.S A. *1,550,473*. August 18th, 1925. BEET ELEVATOR. *Porter C. Baker and John H. Gibson*, of Morrill, Nebr., U.S.A. *1,536,187*. May 5th, 1925. BEET HARVESTER. *James O. Stockstill*, of Rocky Ford, Colo, U.S.A. *1,533,672*. April 14th, 1925. BEET DIGGER. *Joseph Wolny*, of Carneyville, Wyo., U.S.A. *1,550,602*. August 18th, 1925.

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EVAPORATORS. *Griscom-Russell Co.*, of New York (Assignees of *S. Brown*, of Garden City, New York, U.S.A). *236,901*. May 20th, 1925. In this patent, heating elements of evaporators comprise one or more flat convolute coils of tubing of flattened cross section having the broader faces of successive convolutions lying adjacent.—PREVENTING INCRUSTATION OF BOILERS, EVAPORATORS, ETC. *Antiscale Co., Ltd*. *236,534*. June 15th, 1925; convention date July 3rd, 1924. To prevent the formation of crystals, and the deposition of incrustation in boilers and like vessels, the walls of the vessel are subjected to the action of a constant, varying or intermittent magnetic field. Simultaneously, a constant, varying or intermittent weak electric current may be passed through the walls of the vessel.—BASE EXCHANGING SUBSTANCES [PURIFICATION OF WATER, ETC.] *Nordiske Natrolith Aktieselskab*, of Copenhagen, Denmark. *237,626*. July 25th, 1925; convention date, July 25th, 1924. A base-exchanging substance suitable for removing iron, manganese, calcium, and magnesium from water is made by granulating a suitable clay, calcining it at 500–700°C. and then treating with a solution of alkali hydrate or carbonate. For example, the granulated and burnt clay may be boiled for quarter to four hours in a solution corresponding with 1 per cent. of sodium oxide or 2 per cent. of sodium carbonate, the treated clay being washed until neutral before use.—WASHING TRICALCIUM SACCHARATE IN THE STEFFEN PROCESS OF EXHAUSTING MOLASSES. *Carl Steffen*, of Vienna. *237,864*. April 7th, 1925; convention date, July 31st, 1924. In washing tri-calcium saccharate on the filter after filtration, finely ground readily filtrable insoluble substances such as fine saw-dust, well-washed saturation sludge, river sand, finely-ground brown coal, and kieselguhr, are added to the washing water. Substances which act as decolorizers may be used, and the amount added may be from 1 to 2 per cent. of the washing water. These substances prevent the formation of cracks and enable uniform washing to be effected.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1925. Tons.	1924. Tons.
Total Receipts, January 1st to October 28th	2,896,285	2,749,986
Deliveries ,, ,,	2,871,003	2,743,650
Meltings by Refiners ,, ,,	2,826,380	2,705,710
Exports of Refined ,, ,,	243,500	171,000
Importers' Stocks, October 28th	25,282	7,130
Total Stocks, October 28th	81,712	50,309
	1924.	1923.
Total Consumption for twelve months	4,854,479	4,780,684

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1922-1923, 1923-1924, AND 1924-1925.

(Tons of 2,240 lbs.)	1922-23 Tons	1923-24 Tons	1924-25 Tons.
Exports	3,114,777	3,512,100	4,082,059
Stocks	285,550	273,426	639,439
	3,400,327	3,785,526	4,721,498
Local Consumption	98,000	100,000	107,000
Receipts at Ports to September 30th	3,498,327	3,885,526	4,828,498

Havana, September 30th, 1925

J. GUMA.— L. MEJER

Sugar Crops of the World.

(Willett & Gray's Estimates to October 29th, 1925)

	1924-25. Tons	1923-24. Tons.	1922-23. Tons.
CANE.			
America	8,852,285	7,430,186	6,744,377
Asia	5,523,326	5,909,840	5,460,112
Australasia	505,680	339,859	343,832
Africa	577,184	572,035	556,853
Europe	10,629	7,871	13,918
Total Cane	15,469,104	14,259,791	13,119,092
BEET.			
Europe	7,077,791	5,057,761	4,574,325
U.S.A.	974,185	787,217	615,936
Canada	36,200	16,500	12,400
Total Beet	8,088,176	5,861,478	5,202,661
TOTAL CANE AND BEET	23,557,280	20,121,269	18,321,753

United Kingdom Monthly Sugar Report.

Our last report was dated the 9th October, 1925.

The easier tone prevailing last month continued until the latter part of October, when prices reacted and stand to-day practically where they were when we issued our October report.

A large business has been transacted on the London Terminal Market; prices have been marked down 1s. per cwt., but have since recovered again. Large realizations and hedging operations took place but, on the other hand, big buying orders were filled at low prices. These two factors coming at the same time made the market a much more fluid one than it has been for some time and the registrations over the past four or five weeks have been very heavy, probably the largest since the inception of the White Terminal Market. About 16,000 tons were tendered on October, which month finally finished up at 12s. 9d. after having been at one time as low as 12s. 2¼d. November fluctuated from 13s. 3d. to 12s. 3d. to 13s. 4½d., December was very active and sold from 13s. 4½d. to 12s. 4½d. to 13s 7½d., March moved from 13s. 9d. to 12s. 11¼d. to 14s. 3d., May from 14s. to 13s. 3d. to 14s. 7½d., and August from 14s. 4½d. to 13s. 8¼d. to 14s. 10½d. The latest prices are November 13s. 6d., December 13s. 8¼d., March 14s. 3¾d., May 14s. 7½d., and August 14s. 11¼d.

Trading in actual sugars was slow for the first part of the period under review, but when the market reacted the trade—having pursued the hand-to-mouth policy for so long—rushed in and bought large quantities of sugar. No export trade has been done to Germany or Russia, but a certain amount of American Granulated has been sold back to New York. Ready Granulated has been fairly plentiful and sold from 14s. down to 12s. 9d. to 14s. Czecho Granulated for November/December sold from 13s. 10½d. down to 12s. 6d. and back again to 13s. 10½d., whilst Dutch Granulated for the same delivery usually fetched 3d. per cwt. more money American Granulated sold down to 13s. 7½d. c.i.f., but recovered to 14s. 7½d Polish and Hungarian Crystals were offered at the lowest point at 12s. 1½d. f.o.b , and the latest quotation is 13s. 1½d , but no business is reported and there seems to be little market for this class of sugar in the United Kingdom. Belgian Crystals were sold down to 12s. 4½d. but are now asking 13s. 9d.

Spot Sugars have been fairly plentiful. Dutch Granulated sold from 27s. to 25s. 7½d. and up again to 27s. duty paid, whilst American Granulated has usually been 1½d. under this figure.

A few Javas and Mauritius Crystals have been sold at relatively good prices against Fine Granulated. The latest price for White Javas is 26s. to 26s. 6d , and Mauritius 24s. 6d. to 25s. 6d. according to quality.

A start has been made with the marketing of the Home Grown White Sugar, and Kelham, Cantley, and Ely, all sold from 27s. 3d. to 26s. 3d. up to 27s. 6d.

Latterly the British refiners have done more than their usual share of the trade, but at the start of the decline they were not getting on too well. They reduced their prices 6d. per cwt. on October 19th, and a further 6d. on the 22nd of October. This proved to be the bottom for the time being and on October 30th they advanced their prices by 3d. per cwt., on November 2nd a further 3d., on November 4th by 3d., and on November 6th 3d., thus recovering the whole decline of 1s. per cwt. Their latest prices are No 1 Cubes 31s. 9d., London Granulated 28s. 1½d.

A good business was done in raw sugar both to the United Kingdom and the Continent. Old crop Cubans sold down to 9s. 6d. c.i.f., but the latest price is 10s. 6d. after 10s. 9d. having been paid. Peru 96 per cent. sold at one time at 9s. 3d. c.i.f. Mauritius Crystals sold down to 14s. 3d. c.i.f., but the latest transaction took place at 15s. 3d. Preferential B.W.I. 96 per cent. sold down to 13s. c i.f., whilst a cargo of Natal 96 per cent., due early November, was sold as low as 12s. 6d. c.i.f , 88 per cent. Beet was offered as low as 8s. 9d. f.o.b. at the lowest point of the market without, however, any business being reported.

In New York only a fair business has been done in raws. At the lowest point Cuban 96 per cent were sold down to 1$\frac{15}{16}$ c.i.f. New York, but have now recovered to 2⅛. A large speculative business has been done in the Futures Market, which has also recovered about 20 points from the lowest.

Reports of the new Cuban crops are not quite so satisfactory as they were. There were complaints that the month of October had been too dry and that rain was urgently needed. Latterly a certain amount of rain has fallen but the ideas for the final outturn are lower than originally believed, some putting the crop under last year's figure. Stock at the ports is now only 300,000 tons more than last year.

The weather on the Continent has been too wet, and although F. O. LICHT makes no change in his preliminary estimates there is a growing feeling in Continental sugar circles that his figures are too high for some of the countries. It is not anticipated than the final outturn figures will be more than 7,400,000 to 7,500,000 tons.

21, Mincing Lane,
London, E.C. 3.
November 9th, 1925.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE
INTERNATIONAL
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No. 324. DECEMBER, 1925. Vol. XXVII.

Notes and Comments.

The Progress of the Beet Sugar Industry at Home.

The stimulating effect of the beet sugar subsidy in this country is exceeding many anticipations, and a study of the local press of the country districts up and down the shires of England shows the unusual amount of interest that is being taken, and the number of projects for new factories that are being mooted more or less to a successful issue. Every week almost there is now reported some attempt in a fresh quarter to interest the farmers in beet growing and erect a sugar factory in their midst. It will not be very long at the present rate of expansion ere the whole country is mapped out with factory spheres, and we get within measurable distance of the fifty or so factories that some years ago was thought to be a pious hope rather than a practicable achievement.

The greatest task, as we have already mentioned in previous issues, is to ensure that the farmers on once starting keep steadily to their task of supplying roots to keep the factories going without intermission. This crop presents new features for our farming population; it is a ready cash crop which is a distinct advantage for the growers; but these on their part have got to learn that if the factories are to pay promptly they exact in return the necessary condition that deliveries shall be made to time and not at haphazard. It is rather unfortunate that, beginning as early as the first week in November, we have struck one of the severest winters (so far) that has been our experience for a good many years. It has not been a case of "cold snaps" (that well-worn cliché of the daily press) but sustained cold and frost. The result is bound to be delay in lifting roots and getting them to the factory. Roots cannot be got expeditiously if at all out of frozen ground, and by the time they reach the factory they may be half-frozen, in which case their sugar content may be seriously affected. As a consequence of this, we fear those centres of production where factories are starting this year will work under exceptional difficulty, and nothing like a normal average will be struck in the technical figures of production. Much depends of course on how long the frost and snow persist; and if the present type of weather is followed soon by a spell of milder temperature, the drawbacks may be eliminated in the end. Such drawbacks are, of course, an ever-recurrent feature of beet sugar production on the Continent and are accepted as a normal risk. In this country we ought to be much freer from them, taking an average of years, since the climate in this country is as a rule milder in winter than is the case in many parts of the Continent.

Power Alcohol from Sugar Beet.

In November, 1924, the British Empire Producers Organization formed the British Power Alcohol Association, a non-trading body, with the object of supporting any movement for establishing the manufacture of power alcohol in this country. This body has come to the conclusion that while an Empire policy for the production of such alcohol is desirable, it is essential that the industry should be started in this country by distilling from sugar beets, for the reason that in Germany and France the production of beet alcohol has been an established business for many years, and is considered a national industry. But it is considered advisable that the new industry if started should receive Government assistance in its early stages by the granting of a subsidy similar to that accorded to the production of beet sugar.

The Association claim that a power alcohol industry derived from beets as a raw material would not necessarily clash with the existing beet sugar industry, because while the modern sugar factory requires at least 40,000 acres of land in rotation with beets to ensure a steady supply, distilleries can be worked profitably with a supply of as little as 2500 tons of roots per season; consequently there are many parts of England where roots could be grown profitably on a small scale for a distillery but not on the sugar factory scale, thus providing a market for sugar beets in districts that do not conflict with the sugar factory sphere of operations. Moreover the distilleries would work throughout the year, and as soon as the beet season was over would resort to surplus potatoes, damaged grain, molasses, cassava and other Empire products. This would result in lower overhead charges and lower production costs.

In view of these facts the Government was approached by the Power Alcohol Association through the Ministry of Agriculture and the claims of the new industry were urged on their attention. The Ministry was invited to send its expert advisers to the Continent to visit a modern French distillery in order to satisfy themselves that the industry could be carried on profitably. This offer was not accepted, but at the suggestion of the Ministry a firm of accountants visited the French factory and furnished a report which, as it proved, confirmed the figures put forward by the Association. The matter was then considered by the Unionist Agricultural Committee in the House of Commons who after an investigation reported in favour of the claims put forward by the Association, and urged on the Government the desirability of investigating the matter further. The next step now rests with the Ministry of Agriculture and it is hoped that a decision will not be long delayed, so that if the Government are favourable to the idea distilleries can be erected for the 1926 beet crop.

Indian Sugar Factories.

Reports to hand from India and accounts in the Calcutta commercial press reveal what a bad year the Indian modern sugar factories have experienced just lately. The results of the Champaran Sugar Co. (the most successful of the Begg, Sutherland factories) show a profit of £478 only; the Ryam Sugar Company showed a loss of over £12,000, and the Samistipur Central one of nearly £12,000. The new Savan Sugar Co. is also reported to have lost over £11,000. The above are European-controlled factories with good technical staffs, and it may be imagined what the native-owned factories have lost.

These losses may be ascribed to two causes: (1) Unfavourable weather conditions in the year in question, resulting in shortage of cane supplies, so that the mills were not able to work to full capacity; and (2) the competition of Java sugar which sells in India at 9 to 10 rupees per maund of 82 lbs., a price at which Indian factories are quite unable to compete. There is an *ad valorem* duty against foreign sugars entering India, but it can apparently be evaded by lowering the initial cost price; and recent import statistics reveal increasing amounts of cheap Java sugar entering the country to the detriment of the indigenous industry. Thus for the first eight months of 1923, 1924, and 1925, the imports into Calcutta amounted respectively to 130,394 tons, 152,272 tons and 208,360 tons, showing an increase in 1925 over 1924 of fully 25 per cent. Much dissatisfaction is being felt at the failure so far of the Indian Government to protect its own industry. What is wanted is a specific duty (say 20 rupees per maund) on all foreign sugar entering India; that granted, the industry would be on a safer footing and better able to develop its output. It is to be noted that the Indian Government, which has recently acquired immunity from Home control in fiscal matters, has decided to drop the cotton excise duty and maintain the import duty, thus putting the native cotton factories more effectively under protection. Previously the interests of Lancashire demanded that an excise commensurate with the import duty should be levied. The Indian Government has already done a good deal for the agricultural side of the Indian sugar industry, especially by propagating new varieties of cane, but to permit as they do the importation of foreign sugars on the present scale is neutralizing the good effect of their other work, and in the view of some observers is strangling the industry.

It may be added that the position of Indian establishments that refine sugar is apparently even worse. If they buy gur for refining, the average recovery does not exceed 40 per cent. which results in one maund of white sugar costing 21 rupees for the gur *plus* 3 to 4 rupees for refining. Nor is it any better a proposition to refine brown Javas since these are only quoted at 6 annas per maund cheaper than the Java whites, and the latter, as we stated above, are quoted at as low as 9½ rupees per maund.

One effective reason why Indian factories cannot compete with the Java product at present prices undoubtedly lies in the fact that the former are as a rule comparatively small factories, while the Java centrals are of large dimensions. Small factories of a few hundred tons working on Indian cane cannot be expected to compete with 2000-ton factories in Java crushing good cane. That India is tending to put her house in order in this respect can be gleaned from a perusal of the report of the Champaran factory (see below), but a few isolated instances of this sort will not save the Indian sugar industry from the present well-developed foreign competition, so it seems imperative, if the industry is to be saved and the praiseworthy efforts already made to start putting it on a modern basis are not to be rendered nugatory, that the Indian Government should come to its aid by means of much more effective fiscal protection. The Indian sugar industry offers too much hope of ultimate success as a world producer to be stifled at its present interesting stage for lack of adequate Government support.

The Champaran Sugar Factory.

At Champaran for the year ending June 30th last, the quantity of cane handled was the largest on record in the history of the company, and the efficiency of the factory was such that the extraction of sugar reached a higher figure than in any previous year. Contrary to the general experience elsewhere, the factory was able to obtain a full supply of cane; the cultivation of cane has increased considerably in the factory sphere of operations—indeed in order to cope with this increase it has been found necessary to enlarge the capacity. Machinery for the extensions has been purchased and will be available for use from the commencement of the new season. The increase in cultivation of early ripening varieties of cane which is taking place will tend to lengthen the period over which the crushing operations can be carried out, and under these conditions the factory is now equipped to deal with practically double the quantity of cane it has hitherto handled. Present indications are that supplies of cane will be available during the coming season to keep the factory at full work for a longer period than has been the case in previous years. The management therefore anticipate that, even with no improvement in sugar prices, the factory will be able to work at a profit.

Mosaic Disease in the Sugar Cane.

Although there are signs that the flood of literature on mosaic disease in the sugar cane, which has been poured out during the last few years, is subsiding, there is still a great deal of quiet work going on in connexion with this disease in most countries. As in all cases of difficulty in determining the actual causative agent of a disease, a large number of theories have been put forward with regard to the baffling mosaic forms, now often referred to as diseases of the virus type; and it is well to take stock of our position from time to time. Such an attempt has been recently made in Porto Rico, which has been a great sufferer (and outpourer), by **Melville T. Cook**, the pathologist of the Insular Experiment Station in the island; and a summary of his brief review is given on another page of this number of the Journal. It is considered that the opinion of an experienced student of plant diseases, couched in popular language and tersely expressed, may be of interest. It is only natural that a feeling may exist among our readers that the cause of this disease has at last been discovered, after reading references to the results and conclusions of some enthusiast, working along his own special lines. But the very multiplicity of the theories propounded negatives this happy conclusion, and the author of the paper under reference, while holding an even balance as to probabilities, writes "not proven" against each of the seven most important ones discussed.

On the other hand, *any* piece of work which adds to our knowledge of the factors influencing the occurrence and spread of mosaic among sugar canes is likely to be of interest. And it is in this belief that prominence has also been given to a paper recently received, by **Carlos E. Chardoñ** who, although now transferred to another sphere of work, will still be remembered for his important observations as to the transmission of the disease in Porto Rico through the agency of *Aphis Maidis*. He deals, it is true, with one isolated fact, strictly applicable only to the many countries which have an ocean coast line: his preliminary report of work done indicates that mosaic-free nurseries may be easily obtained in fields near to the sea. This location of a suitable site for such nurseries has been an outstanding problem in many countries where the disease has secured a strong hold, and it occurs to us that the facts disclosed will not be valueless even in those countries where no sea coast is available. The work offers a fresh suggestion as to the way in which local environment may have an important influence on the incidence and spread of the disease; and, if we mistake not, the ingenuity of expert workers may find a new field for experiment in the subjugation of this baffling disease after reading Chardoñ's paper.

Notes and Comments.

The Sugar Industry in Formosa.

The Formosan sugar industry is probably the least reported in the world's sugar press of all those countries that produce appreciable quantities of sugar. The language difficulty is doubtless an insurmountable one, as the average English-speaking journalist, even if he had a penchant for languages, seldom or never acquires a knowledge of Japanese, hence reports issued in that language are quite impossible of assimilation in ordinary practice. For the following notes on Formosa sugar production we are mainly indebted to a Far East exchange.

It was only when Formosa was ceded to Japan, in 1895, that the manufacture of sugar there made real development. In 1896 sugar seedlings were imported from Hawaii, and shortly after the Mitsui Co. erected what was said to be the first modern sugar factory in the island, having a capacity of 200 tons per diem. In 1902 the well-known Rose Bamboo and Lahaina canes were imported from Hawaii, and these remained the standard canes till recently, when owing to their liability to attack from pests and diseases, and to damage from typhoons, they began to be replaced by Java seedlings which now cover nearly 80 per cent. of the total acreage.

The Mitsui Co.'s factory was soon followed by others, the greatest being the Toyo sugar establishment with an output of 1000 tons per diem. Then the Nippon Co. came on the scene and built a factory of a capacity of 1200 tons. Eventually there were 24 different companies producing sugar in Formosa; but with the realization of the disadvantages of excessive competition, amalgamations began to be effected, and by 1916 the number of firms was reduced to 10, with an aggregate capital of 140 million yen (say £14,043,000). Three new companies were afterwards started, so at present there are 13 companies possessing 45 factories run on modern lines. The capital invested is put at some 270 millions of yen. Financial depression since the great war has, however, affected the sugar industry adversely, and further amalgamations are shortly expected.

In Formosa artificial irrigation is very inadequate, and most cane fields have to rely entirely on rainfall. Planting begins in September, and the harvest takes place in the November-May period of the following year. Originally cane was planted in rotation with other agricultural products, but as the industry developed fields were retained exclusively for cane cultivation, the plants being usually ratooned twice.

The Formosan Sugar Crop.

The Acting British Consul of Tamsui reports[1] that, following upon the first official estimate of the sugar crop in Formosa for the 1924-25 season of 7,679,118 piculs, or about 453,500 tons, and a second forecast of 7,806,933 piculs, or 461,000 tons, the actual production was approximately 7,992,349 piculs, or about 472,000 tons. The area under sugar was 115,046 ko., equal to about 275,730 acres. As regards the 1925-26 crop, the first official forecast is for a yield of 8,101,763 piculs, or 492,000 tons of centrifugals, and 272,364 piculs of brown sugar, giving a total of 8,374,127 piculs, or 492,800 tons, from an estimated total area of 108,897 ko., or 260,993 acres. Thus there is an estimated increase in production over last season of some 22,000 tons from an estimated decrease in the area under sugar of about 14,737 acres. According to local press reports, only four companies planted up to or beyond the area originally estimated by them; the majority planted from 80 to 90 per cent., and one company only 62 per cent., owing to the strength of the market for rice.

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[1] *Board of Trade Journal.*

Fifty Years Ago.

From the "Sugar Cane," December, 1875.

In this number the article by R. H. Burton on "The Distillation of Rum," in the main a mass of conjectures on a subject which is still insufficiently understood, was again continued, and further extracts may be reproduced from it.

"Molasses and skimmings, particularly the latter, are essential in rum-making. To the skimmings, the rum is indebted for its particular flavour, but there are also some molasses more adapted for profitable distillation than others; in fact, I opine that molasses drained from sugar made in slow evaporating coppers, giving an inferior, clammy, soft sugar, makes the best flavoured rum; and, although as much spirit may be obtained from molasses made under a better process, yet it is not of the same flavour. It is a well-known fact in Ireland that small distilleries, working under difficulties to avoid Excise officers, made the best flavoured whiskey, and that the large distilleries could not make a spirit of equal flavour. May it not be so with rum-making? . . . . Distillation of rum deserves the attention of practical chemists, and merits their scientific knowledge to test the effects of temperature on various kinds of sweets, and the different modes of combining these. . . . . . The wash should be mixed in such proportions as practice demonstrates will attenuate in the least time for a given crop to be made, requiring a smaller liquor loft and number of fermenting vats than the old system still carried on in many islands of sweet mixings and long attenuations would require. Attention to this has taught the Jamaican distiller how to make in a given period, and maybe with the same description of apparatus, three or four times as much spirit as would be turned out from a given number of fermenting vats in other places, where one-half the molasses supposed to be required is kept back and thrown into the wash on the second day, and where daily the skimming and stirring of the wash in the vats is practised. . . . It stands to reason that the full amount of strongest spirit contained in the wash can only be obtained in common stills by great attention to the quantity of fire used under them; this at first should be moderate, and increased only as the quantity and strength of spirit decreases. All distillers know that the smaller the thread of spirit running from the worm, the greater is the return of strong rum, but this is frequently sacrificed to time. . . . . No amount of argument will persuade me that dunder should not be used in the mixing cisterns. That there is a right and a wrong way of doing it, I am convinced. Fresh dunder containing a considerable amount of gluten requires a putrid fermentation, which loosens the elements of this from their former conditions of combination; the yeast thus formed in it must impart a special flavour to the spirit, as well as act on the wash with which it is set up. Consequently, dunder should be subsided and exposed to the atmosphere. Those who argue against its use have probably not taken the precaution to draw it off free of all sediment. I am inclined to think it might be an advantage to filter the dunder; clear dunder is a very different article to that which is most frequently used in mixing cisterns . . . . . So far we have only mentioned quantity, but that quality is also affected by the use of dunder is proved by the fact that the island where the greatest quantity of dunder is used in the wash is precisely that which produces the most valuable rum. . . . . ."

The World's Production of Sugar Beet, and the Expected Output of Sugar.

The International Institute of Agriculture in the November issue of its *Bulletin of Agricultural and Commercial Statistics*, gives the following estimates of this season's sugar beet harvest. We have converted their figures into metric tons.

PRODUCTION OF SUGAR BEET
(*Metric Tons.*)

	1925	1924	AVERAGE 1909-13
Europe (11 countries)	32,695,000	32,895,000	32,485,000
Canada and United States	6,965,000	7,815,000	5,015,000
Total	39,660,000	40,710,000	37,500,000
Soviet Union	6,460,000	3,705,000	10,925,000
Grand total (14 countries)	46,120,000	44,415,000	48,425,000

The figures of production, so far as ascertained, represent about four-fifths of the world's yield of sugar beet; the data of France, Italy, and of a few countries that are smaller growers, are not yet to hand. On the basis of the above-mentioned results and taking into account the reports almost all favourable, from those countries which have not yet published their estimates. it may be assumed that the European sugar beet production of this year is very nearly equal to that of last season. This result seems to be a satisfactory one, when it is remembered that 1924 was the first year reaching the pre-war average.

The North American estimates show an improvement over those of last month, both for Canada and the United States; but still indicate a deficiency when compared with the good yields of previous seasons. Within the limits of ascertained data the production of sugar beet (excluding that of the Soviet Union) is 2·6 per cent. below that of 1924, and above those of 1923 and of the pre-war average, by 20·1 per cent. and 5 7 per cent. respectively.

Including the production of the Soviet Union, this year's output may be considered as surpassing that of 1924 by something like 3·8 per cent.

The sugar content, to all appearance, is not very different from that obtained last year, and, if account is taken of the beet production figures already to hand, it may be estimated that the yield of beet sugar this season will not vary greatly from that of last year.

A certain number of countries (which, between them, account for 70 per cent. of the world's beet sugar output) have already begun to furnish estimates of the probable production. These are summarized in the following table:—

ESTIMATED PROBABLE OUTPUT OF BEET SUGAR.
(*Metric Tons.*)

	ESTIMATE 1925-26	ACTUAL OUTPUT 1924-25.
Germany	1,692,330	1,740,070
Czecho-Slovakia	1,584,480	1,572,810
United States	980,685	1,232,960
Poland	619,830	605,500
Belgium	396,850	434,850
Other countries[1]	648,605	572,745
Total	5,922,780	6,158,935
Soviet Union	947,990	454,760
Grand total (12 countries)	6,870,770	6,613,695

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[1] Hungary, Sweden, Denmark, Switzerland, Finland, and Bulgaria.

Excluding the production of the Soviet Union, the output of sugar expected this year is a little less (4 per cent.) than that obtained in 1924-25. However, the Russian figures are much better than last year's; and, if they are added, the data at present available would indicate an increase of 4 per cent. over 1924-25.

Milling of Uba Cane in Natal.

By R. F. HUTCHESON.

INTRODUCTION.

Only within the last decade, it may be said, has the sugar industry of Natal paid much attention to reducing the losses in the grinding of the cane and securing the maximum extraction obtainable by the rollers. Certain factories have maintained strenuous endeavours to improve their crushing plant in both numbers and varieties of units, but actual milling performances have not received that amount of attention which the importance of this subject demands.

Many reasons may be assigned for this apparent neglect, but the principal may be due to the early adoption of plant designs laid down for countries crushing soft cane. In recent times, however, engineers and designers have given the Uba cane, as grown in South Africa, the special attention it demands, and the result is now seen in the many additions and alterations to crushing plants, whereby an extraction of 90 per cent. of the sugar contained in the cane is of fairly common occurrence.

Uba cane is characteristically difficult to handle. Rainfall, general conditions of growth, and cultivation, render uniformity of length, diameter, fibre contents, rind hardness, elusively inconstant factors. Engineers are now agreed that extra equipment is necessary to cope with this high fibre and hard rind, if economical results are to be obtained, especially as South Africa is now competing in the world's sugar market.

Following the physical nature of the cane, its juices are likewise characteristic and require a chemical treatment of a much more intense nature than in other countries. Heavier sulphuring and liming, and greater capacity of defecation tanks, filter-presses, crystallizers and centrifugals are necessary.

Hence, in addition to a milling plant incapable of a sufficiently high extraction, there has been an unbalanced internal capacity, resulting in a tendency to enlarge the boiling house to permit the constant running of the mills.

A further factor has been the constant increase in acreage put under cane, the natural consequence being that the Central Factory was being gradually overloaded to the detriment of really satisfactory efficiency. In many cases, the aim has been to get as great a tonnage as possible through the mills.

Conditions, however, have now been gradually adjusted, and to-day one observes a healthy rivalry in the protagonists of one class of unit as against another, from which nothing but common good can come. Already mills are running more constantly; time wasted in stoppages for lack of internal capacity is being eliminated; and less auxiliary fuel, always an expensive item in milling costs, is being purchased.

More intensive crushing, whilst it may throw additional work on the boiling house, has secured a better fuel value for the bagasse going to the furnaces.

In discussing mill efficiency the following are the principal factors which favour extraction: (1) Physical condition of fibre; (2) cane carrier feed; (3) preparing the cane for the mills; (4) grooving of the rolls; (5) openings between the mill rolls; (6) speed of the mill rolls; (7) setting of the trash plates; (8) pressure on the top rolls ; (9) application of maceration water.

As the most common milling plant in Natal consists of four 3-roller mills, the rolls being 32 in. diam. and 66 in. long, almost invariably preceded by a cane preparing unit, all subsequent discussions are based on units of a relative size.

PHYSICAL CONDITION OF FIBRE.

Probably the hardest of the commercial sugar canes is the Uba variety, the average fibre content being 16 per cent., but figures about 20 per cent. are not uncommon. Its average thickness may be taken at ⅞ in., but here again the limits vary largely, cane having been received by the writer of a diameter varying from ⅜ in. to 1½ in. Of greater importance than the actual fibre content, is its high proportion of rind tissue. F. J. SCARD makes appropriate mention of this when he says "a stout cane will contain less vascular or rind fibre in proportion to the cellular or pith fibre than a thinner cane of the same variety, and although the percentage of fibre in the canes is the same, the difference will be at once apparent when it comes to the question of the canes being crushed in a mill."

As the milling of cane may be said to consist of compression of woody matter, it is obvious that, as before remarked, mills designed for 10 per cent. fibre containing a large proportion of pith tissue cannot be expected to give economical results in working Uba cane with a fibre of decidedly different qualities.

CANE CARRIER FEED.

Essentially necessary for high extraction is an even feed to full capacity. The usual methods employed are hand feeding, cane rakes, tipping of trucks and grabs, the selection depending largely on the class of truck in which the cane is brought to the carrier, whether by small trucks of 3 tons belonging to the estate, or in large trucks of 25 tons belonging to the Government Railway.

If the small 3-ton trucks are used, cane rakes or tipping is perhaps the most practicable method, though the cane must be straight, since should it be bent or twisted, it falls on the carrier in a tangled mass. On the other hand, if the cane is brought by the large trucks the grab worked by a derrick or an overhead gantry is the best. To-day, however, sees most modern factories employing the grab for off-loading, and direct feeding of the carrier.

The grab is constructed to raise 1⅛ tons of cane per lift at 40 lifts per hour. One grab is therefore capable of keeping the average large-sized factory supplied.

Despite the value of the mechanical off-loader (and it is a very great asset) the old if expensive method of hand-feeding is undoubtedly the best. Hand-feeding may secure that even supply of cane which makes for regular crushing. No matter how carefully manipulated, the cane rake, tipping or grab never overcome either that accumulation of cane or the gap on the carrier, which causes the carrier to be either slowed down or speeded up, thus disturbing the evenness of supply. The constant employment of the clutch at the carrier drive does not conduce to good extraction.

PREPARING THE CANE FOR THE MILLS.

Concurrently with mechanical loading, the use of revolving knives has been adopted. Although knives are used in some countries for cutting the cane into small pieces, in Natal they are only used for levelling the feed, though actually their purpose is to cut the uneven twisted mass of cane as deposited by the mechanical off-loader and beat it down to a level blanket. A divergence of opinion exists as to the best type, and as to the speed at which these knives should be run. The writer's experience clearly demonstrates that to secure the best results they should be set at 18 in. from tip of blade to carrier slat, which incidentally should be of the corrugated steel type, the shaft carrying the blades revolving at from 300 to 350 revs. per min., depending on the length of the blade.

No factory using mechanical means to feed the carrier can fail to benefit by the knives. In addition to improving the feed, an increase in crushing capacity from 5 to 10 per cent. may reasonably be looked for.

Crushers.—Most factories have at some time or other used the Krajewski type of crusher to prepare the cane. It consists of two rolls having zig-zag teeth about 6 in. pitch intermeshing, the points of the teeth of the one being set at about ½ in. from the roots of the teeth of the other. It has been the practice to have the diameter of the rolls less than that of the mill rolls, usually about 4 in. less and to run them then at a greater speed. In the writer's opinion this is wrong. Indeed so far is he from agreement with this idea that he would prefer the Krajewski rolls to be about 2 in. larger in diameter than the mill rolls, and run at a slower speed than the first mill.

A Krajewski doing good work will extract about 35 per cent. of the sucrose in the cane. It should be driven independently of the mill engine.

Shredders.—The Searby Shredder has made its introduction into Natal, and the company using it have been most enthusiastic concerning its successful application to Uba cane. It does not, however, seemed to have found favour in this country; the chief reasons against it seem to be the power required to drive it, and the upkeep; also, its employment necessitates the usual preliminary crusher. In addition to the crusher taking about 70 h.p., the shredder driven by a direct coupled motor takes about 150 h p. Thus, apart from the cane knives, the preparing of the cane takes up 220 h.p. This plant, consisting of revolving knives, crusher, shredder, and four mills, gets an average extraction of 91 per cent. of the sucrose in the cane.

Double crushers.—The double crushers have found much favour in Natal, for during the last three years five double crushers have been installed with the prospect of more to follow. The majority of these installations are of the Fulton type, and without doubt the high standard of work done merits the good opinions held of them. The adoption of the double crusher has been responsible for an increase in the extraction up to 5 per cent., with an increase of tonnage crushed per hour of 25 per cent. and in some cases higher. These crushers consist of two units each of two rolls having large V-grooves intermeshing with longitudinal groove spaces, at 6 in. apart, of a depth of half that of the circumferential groove.

Grooves of the first crusher are 3 in. pitch, top and bottom rolls intermeshing so that the points of the grooves in the one roll are ½ in. from the roots of the grooves in the other roll. The second crusher has the rolls grooved 2½ in. pitch similarly placed, but with the distance between the point of the one and the root of the other reduced to ⅛ in. Both top rolls are equipped with hydraulic caps. A well-adjusted Fulton double crusher will extract 65 per cent. of the sucrose in the cane.

GROOVING OF THE ROLLS.

Hitherto the grooving of the rolls has been a matter of personal experience on the part of the factory engineer, although probably a 60° V-groove ⅜ in. pitch was the common practice with the feed and top rolls of the first mill in many cases ¾ in. pitch, the great difficulty being the slipping of the rolls due to the hardness of the fibre necessitating a constant touching up to maintain the sharpness. As this groove did not provide for the rapid carrying away of the juice, especially if maceration water was employed to any great extent, flooding and re-absorption were a perpetual source of trouble. But the introduction of the Messchaert grooves, particularly on the feed roll of the second and subsequent mills, solves this trouble, some engineers even adopting them on the discharge rolls. This grooving is kept clean by scrapers held in position by a bar fastened to the headstocks. Trouble has been experienced with these scrapers working loose and falling out or breaking. The writer has found the best position to place them is underneath the roll, the point of the scraper which enters the groove being 3 in. in front of the vertical centre line through the roll.

As an additional help to feeding, the pusher, either driven from the first motion gearing shaft, or by an independent motor, may be installed. These devices usually have a stroke of about 10 in., and come down to within 3 in. of the feed roll, working at a speed of about 80 strokes per minute.

Modern Hawaiian practice favours large grooves intermeshing, which entirely coincides with the writer's personal experience. The following is the practice which seems to be favoured in Natal at present: The first mill has all rolls grooved with 60°V-grooving 1 in. pitch intermeshing; those in the others having ½ in. pitch intermeshing.

This grooving might be carried still further so that the feed rolls of all mills have 1 in. pitch grooves. With this large grooving on the feed roll there will be no danger of flooding, and 40 per cent. or more maceration water can be applied. It has successfully displaced the need of the patent Messchaert groove and the pusher as previously described.

There is now a tendency to make all grooving 1 in. pitch intermeshing, and if the success of previous work along this line be taken as a criterion, any rational grooving ought to be tried out, either as a means of increasing the extraction, or the tons of cane crushed per hour. With the introduction of large intermeshing grooves, the writer's opinion is that the 32 in. diam. rolls should be replaced by 33 in. diam. rolls.

OPENINGS BETWEEN MILL ROLLS.

With the first mill rolls grooved ¾ in. pitch and the others ⅜ in. the following openings give good results:—

	FEED.	DISCHARGE.
First mill	1 in.	½ in.
Second mill	¾ ,, ...	⅜ ,,
Third mill	½ ,, ...	¼ ,,
Fourth mill	⅜ ,, ...	1/32 ,,

With the first mill rolls grooved 1 in. pitch and the others ½ in. pitch intermeshing, the following are good:—

	FEED.	DISCHARGE
First mill	⅝ in.	¼ in.
Second mill	½ ,, ...	¼ ,,
Third mill..	⅜ ,, ...	1/16 ,,
Fourth mill	¼ ,, ...	¼ ,, intermeshing

If the train is preceded by a single crusher, the above openings will pass through 35 to 40 tons of cane per hour, if by a double crusher, from 45 to 50 tons of cane per hour.

SPEED OF ROLLS.

To get good extraction the rolls must be run as slowly as possible, as a slow heavy feed will give better results than a fast light speed. The following speeds suit the above openings and tonnage:—

Peripheral speed of 1st mill rolls 17 ft. per minute.
,, ,, ,, 2nd ,, ,, 18 ,, ,, ,,
,, ,, ,, 3rd ,, ,, 19 ,, ,, ,,
,, ,, ,, 4th ,, ,, 20 ,, ,, ,,

SETTING OF TRASH-PLATES.

The high fibre of the Uba cane requires the trash-plate set much lower than is the practice in other countries where the fibre in the cane is less. From numerous trials the following adjustments have been found to be the most satisfactory:—

With the Small Grooving.

First Mill ¾ in. pitch ; others ⅜ in.

	From top roll to point of plate. *A*	Between top roll and plate at centre line of roll *B*	From top roll to heel of plate *C*
First mill	2¼ in.	2½ in.	2⅞ in.
Second mill	2¼ ,,	2⅛ ,,	2⅞ ,,
Third mill	2 ,,	2¼ ,,	2⅝ ,,
Fourth mill	1¾ ,,	2 ,,	2⅜ ,,

With the Large Intermeshing Grooves.

1st Mill 1 in. pitch, others ½ in.

	A	*B*	*C*
First mill	2 in.	2¼ in.	2⅝ in.
Second mill	2 ,,	2¼ ,,	2⅝ ,,
Third mill	1¾ ,,	2 ,,	2⅜ ,,
Fourth mill	1½ ,,	1¾ ,,	2⅛ ,,

The width of the trash-plate should be kept as narrow as possible. If the plate is wide, the mill is liable to choke on account of the great friction between the top-roll and the plate.

PRESSURE ON TOP-ROLLS.

Modern mills are equipped with hydraulic plungers on the top-roll journal capable of exerting heavy pressure. The rigid mill is gradually going out of date, although from an extraction point of view its worth is not eclipsed by the hydraulic. The liability to crack and break the shells of the rolls, especially the top-roll of the last mill is a serious factor leading to the abandoning of the rigid mill. The following pressures are an average of those found in Natal:—

Total Pressure on Top Roll.

	Tons
Crusher	250
First mill	275
Second mill	300
Third mill	350
Fourth mill	400

APPLICATION OF MACERATION WATER.

With the high fibre in cane the water applied in Natal amounts to as much as 30 per cent. of the weight of the juice, that is, to the limits of evaporating capacity. The higher the fibre the greater is the amount of water applied to assist in the extraction.

The question of the efficiency of hot water as against cold water has received much consideration, although the consensus of opinion, that one has no advantage over the other, may be true in respect of the extraction.

Many factories apply the returned condensed water from the intermediate vessels of the evaporators, but this practice has nothing to commend it except in the case where the supply of water is not plentiful. Its acidity involves neutralizing in the juice preparing tanks, whilst the depreciation in piping is very great by reason of corrosion.

As a rule the maceration water is recorded by means of a water-meter, an accurate measurement being necessary for the technical control of the milling plant. The water is applied through perforated pipes at a pressure of about 25 lbs. per sq. in., and the pressure maintained, either by a pump or a steady head tank.

As to the methods and places of application, on this subject as in many others engineers have their own particular likes and dislikes based on observation, but the following is common practice: (*a*) As the bagasse leaves the second mill; (*b*) before the bagasse enters the third mill; (*c*) as the bagasse leaves the third mill; (*d*) before the bagasse enters the fourth mill.

As the juice coming from the last unit is in a very low diluted state containing about 5 per cent. solids, it is generally pumped back to macerate the bagasse between the first and second mills. As this juice is full of small pieces of "cush cush," or *bagacillo*, it cannot go through a perforated pipe, so is pumped into an open gutter and overflows on to the bagasse. The overflow edge is so arranged that the juice runs over the full width of the carrier.

Until recently the steel corrugated slat type was in universal use in this country, but the Ramsay scraper type is gradually displacing the slat type owing to cleanliness.

MOTIVE POWER FOR MILL ENGINES.

All mills in Natal are driven by steam engines. Whilst it is recognized that for best results each mill should be driven independently (a method costly in outlay, maintenance and steam consumption), the common practice is to have two engines, the first driving the first and second mills and the second driving the third and fourth. Some have but one engine driving the whole plant; whilst one factory has the one engine driving the first and second mills with separate engines for the third and fourth mills. By this layout the last mill is under perfect control. But whatever number of steam units may be employed, it is essential that the gearing be arranged so that the necessary increase in speed may be secured.

With a plant having two engines, each driving two mills, the h.p. developed by the first engine is about 240 and by the second 260 h.p., which with a single crusher developing 75 h.p. makes a total of 575 h.p. to crush about 40 tons of cane per hour.

Indicator cards should be taken at regular periods to ascertain whether the engine and the mill are doing their proportion of the work.

SUMMARY.

For the efficient milling of the Uba cane the following appear to the writer to be the outstanding points:—

(1) Good feeding at the cane carrier; (2) the cane carrier to be driven by an independent engine or motor with a variable speed; (3) levelling knives; (4) a double crusher; (5) all rolls provided with large intermeshing grooves; (6) rolls run as slowly as possible; (7) trash plates kept low; and (8) heavy maceration.

The highest extraction figure obtained in Natal over a season's working has been 91 per cent. of the sugar in the cane; but, with further concentration on the subject, the writer is confident that higher figures may be looked for in the near future.

A new material for roofing, namely, copper-clad asphalt shingles, made by a process termed "galvanoplastry," is announced in America. One of the dreams of electro-metallurgists, the commercial production of a copper-covered non-metallic substance, is claimed thus to have been accomplished and adapted to industrial use on a large scale.

The Sugar Industry in the British West Indies.

(Department of Overseas Trade Report).

The following account of the state of affairs in the sugar industry in the British West Indies and British Guiana is taken from a report prepared by Mr. J. L. WILSON GOODE, H. M. Trade Commissioner for the British West Indies, as issued by the Department of Overseas Trade.[1]

The fact that the quantity of sugar produced in the British West Indies and British Guiana is small as compared with the world's production in no way detracts from the value of the industry, either to the producing Colonies or to the British Empire as a whole. The importance to the Empire of being able to obtain requirements from British sources is becoming increasingly recognized, and the possibility of a British Empire Sugar Association being formed for the protection and development of the sugar industry of the Empire is being carefully considered by interested bodies. According to Messrs. Willett & Gray, the total production of sugar cane crops during the year 1924-25 represented approximately 14,595,098 tons of sugar. Of this quantity 10,894,922 tons were produced in foreign countries including Egypt, as compared with 3,700,176 tons in the British Empire. But the total British production included 2,537,000 tons produced in British India, and as most of it was required for internal consumption in the form of *gur*, and as India spends about ten millions sterling a year on imported sugar, the British grown cane sugar available for the rest of the Empire is very small indeed. The total production of the British West Indies and British Guiana during the year 1924-25 was approximately 292,300 tons.

Since the heavy fall in values in 1921 the sugar industry of these Colonies has experienced difficult conditions, and in many cases the position has been aggravated by the over-capitalization of many of the estates about the year 1919. During the close of the year 1923 and the first two months of 1924, a decided improvement was experienced, but in March, just as planters were beginning to feel that their position was more stable, a severe drop in values took place, adversely affecting the estates, which were left with a large quantity of sugar unsold.

The area under cultivation in 1925 has much increased, and the year is likely to be an exceptional one. Both supply and demand are unusually large, in spite of the important developments in the beet sugar industry, and a greater feeling of confidence now prevails. Prospects are all the brighter since the announcement of the Imperial Government's decision to maintain a preference on Empire grown sugar imported into the United Kingdom of approximately one halfpenny a pound, so long as the duty itself is not below that rate.

Greater use is now being made of mechanical tillage which serves the dual purpose of lessening production costs and of offsetting the effects of any labour shortage, as in the case of British Guiana. Until last year the demand was confined almost exclusively to American tractors, but since then, power ploughs of United Kingdom manufacture have been introduced with beneficial results, especially as the motor spirit required is obtainable from the residue of the cane These ploughs are peculiarly suitable to cultivation in British Guiana owing to the system of cross drains which prevails in that Colony.

It remains to be seen to what extent, if any, the demand for British West Indian sugar will be enhanced as a result of the Ottawa Conference, but there is no doubt that the planters in these colonies would like to see the Dutch Standard test for raw sugar abolished in Canada, to which country they are looking more than ever before. Such a change would probably not be approved by the Canadian refining interests. No doubt it would open the Canadian market for West Indian light crystals, but it is doubtful if the sales of these would be large.

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[1] H. M. Stationery Office, 1925, 2s. net.

Concurrently with the decline in the demand for rum, the demand for molasses became almost negligible and remained so for some time; but latterly there has been a revival of trade in this product. The old West Indian method of shipping molasses in puncheons has been abandoned, and tank steamers are now in general use.

The approximate number of acres under cultivation in sugar crops in the West Indies is as follows:—

	ACRES
Jamaica	45,411
Trinidad	35,166
British Guiana	57,190
Barbados	35,000
Antigua	16,480
St. Kitts	6,500
Nevis	—
Dominica	
Grenada	—
St. Lucia	4,750
St. Vincent	1,500

Jamaica.—The estimated production of sugar in this Colony in 1925 is 48,000 tons, or almost twice what it was for either of the two previous years, and as the colony's output of rum for 1925 is also high it is safe to assume that the industry of Jamaica is now on a firm foundation with every prospect of improvement. It is probable that, after the requirements for domestic consumption have been met, the amount available for export will approximate to 40,000 tons, which is a higher figure than the average since 1919. According to an estimate of the Collector-General for the Colony, the sugar crop reaped since the beginning of 1925 was selling up to the end of February at an average price of £18 per ton.

Important developments are pending. Golden Grove, for long one of the banana plantations of the United Fruit Company, has been transferred to the Jamaica Sugar Estates, Ltd., and is growing sugar cane which will assist to feed the 10,000 tons factory in the parish of St. Thomas. Having regard to the improved conditions in the sugar industry in Jamaica, it has been definitely decided that the operations of the Jamaica Sugar Board must cease on June 30th, 1925, and that the Board must then proceed to wind up its affairs.

Trinidad.—The outlook in this Colony is favourable. Cane farmers have increased their cultivation, and weather conditions continue satisfactory. The 1924 crop was 52,045 tons, as compared with 41,619 tons in 1923. The exports for 1924 were as follows:—

	Weight.	Value
Sugar	43,423 tons	£1,233,944
Molasses	1,505,881 gallons	24,843
Rum	82,751 gallons	18,063

The final returns for this year are not yet complete, but it is estimated that the 1925 crop will approximate to 70,000 tons.

Unfortunately considerable damage has been done to the sugar canes of Trinidad by the froghopper pest. Proposals for further research into the problem of dealing with this destructive insect are receiving attention.

Barbados.—Prosperity has been well maintained in this island. The 1924 crop consisted of 43,519 tons of sugar and 13,713 tons of fancy molasses, and the shipments of sugar during that year were 41,340 tons valued at £997,869, and of molasses 5,987,453 galls. valued at £524,927. The 1925 crop is likely to exceed 70,000 tons. On the 28th May last the deliveries from the estates represented 46,710 tons of sugar and 19,510 tons of fancy molasses, and it was estimated that there were about 5000 tons still to be delivered. The new crop is badly in need of rain, and it is hoped that the long spell of drought will soon break.

The following table gives a comparison in terms of sugar alone (equating fancy molasses thereto) of the exports from Barbados for the past five years:—

	Tons
1920	48,212
1921	36,005
1922	51,074
1923	62,711
1924	54,493

The decrease of 8218 tons on the crop of the previous year was to a large extent caused by the low rainfall during the year 1923.

British Guiana.—In 1924 drought curtailed the sugar crop which amounted to 90,874 tons from an area of 46,422 acres. In that year an effort was made to supplement the labour of the Colony by East Indian immigration, but the possibility of drawing labour from India is now regarded as remote, and other sources of supply will have to be tapped if this vast and rich area is to receive the attention it deserves. The estimates for the 1925 sugar crop are 99,596 tons from an area of 51,293 acres, but the crops for this year are so good that it is believed by some of the leading planters that the estimates will be exceeded.

Antigua.—Dry weather prevailed in Antigua from the beginning of 1924 to August 28th of that year, when a hurricane visited the Colony, and, whilst doing damage to the extent of several thousand pounds, brought relief in the form of welcome rain. The annual report of the directors of the Antigua Sugar Factory Limited for 1924 states that the Island has passed through one of the worst years for crops ever experienced, partly the effect of the series of droughts in recent years, but still more the result of severe drought during the crop season, which reduced the quantity of canes reaped by 25 per cent. below the estimates made at the beginning. The greater number of the estates had yields of only 4 to 9 tons per acre, and the average of the island was 8 tons. In consequence of the shortage of cane due to these causes, the margin of profit for the year is disappointing. The prospects for the coming crops are at present all that could be desired.

During 1924 the sugar output of the two central factories (Gunthorpes and Bendals) declined to 7573 tons, including 231 tons of white sugar manufactured by the Bach process. The little muscovado sugar produced, which amounted to about 100 tons, was consumed locally last year. 352,770 galls. of molasses, consisting almost entirely of vacuum pan molasses, were exported. No fancy molasses or choice syrups were manufactured or retailed. This is the lowest output of sugar from the Presidency since 1911, and indicates the cumulative results of the drought recently experienced. It is estimated that the 1925 crop will approximate to 16,000 tons.

Grenada.—There has been an extension of cultivation of sugar cane, especially in the southern part of the island. But the attempt to raise capital in England for the erection of a central factory in the parish of St. George's has not yet fructified.

St. Kitts-Nevis.—The sugar crop for 1924 was 9,699 tons. The estimates for 1925 are 15,000 tons. This is regarded as a large crop, but it falls a long way short of production between the years 1884 and 1894, when a yearly average of 24,000 tons was realized.

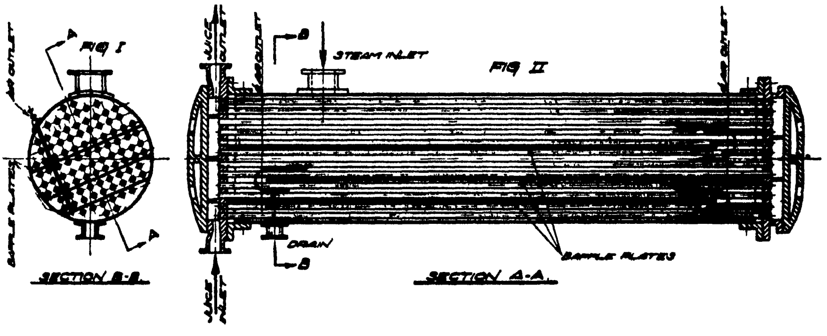
St. Lucia.—The output for the 1925 crop is expected to give an increase of about 25 per cent. over the yield for the previous year. This is due principally to improved cultivation and extension of area under cane. The exports for the year 1924 consisted of usine sugar 3588 tons, muscovado 497 tons, and fancy molasses 159,589 galls.

The Baffle Juice Heater.[1]

By SEYMOUR TERRY.

This subject of the baffle juice heater has been presented before,[2] but the advantages of this design over the old style are so well assured that it is thought worth while to repeat these good points.

Two such heaters recently built by the Honolulu Iron Works Company each had seven tubes per pass, 22 passes, and 829 sq. ft. of surface. The covers were of cast-iron, designed on the girder principle and carried by hinges cast with the covers and heads. The heads were of bronze, which, though of slightly higher first cost, is a safeguard against cracking, the fate of many cast-iron heads. The expensive swing bolts common on the old heater were replaced with standard machine bolts for which sufficient distance is allowed between the head and flanges to enable inserting them from the back.



ATED WITH BAFFLES

To open the heater door, the nuts are taken off and the bolts pushed back, leaving them in place. Cast-iron is quite satisfactory for the flanges and steel plate for the shell of thickness to suit the different diameters. The baffle plates (see figure) are $\frac{3}{16}$ in. steel plate shelves secured to the shell and arranged to give a decrease of cross section to the steam flow as condensation takes place, thus maintaining an approximately steady velocity of steam. The greater condensation takes place on the lower tubes due to the greater temperature difference at this part of the heater, and the reduction in the number of tubes between baffles gives better tube drainage where it is needed. The tubes are 1¼ in. O.D. copper No. 16 gauge, 15 ft. long. This is probably the maximum length that can be used without a centre support and yet allows of rolling in both heads, which is an advantage over having to use ferrules. As to the advantages of this heater in operation over the old style, these are divided into two main features:—

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[1] Abridged from a paper presented to the Fourth Annual Meeting of the Hawaiian Sugar Technologists, Honolulu, October, 1925.   [2] *I.S J.*, 1922, 81, 1925, 43.

(1) Condensate on the tubes, instead of dripping from tube to tube and so forming a wet coating on the lower tubes through which the heat of the heating steam has to traverse, is collected by the baffle plates and drained to the sides of the heater. When consideration is taken of the fact that in a 900 sq. ft. heater about 12,000 lbs. of water per hour are drained away, this advantage is quite evident.

(2) Heating steam is kept at an effective velocity in a definite direction right through the heater. This steam flow is in part a counter flow to the juice.

Several of these heaters are now in operation in Hawaii. It is generally accepted that the old-style heater heats 60 to 70 lbs. of juice per hour per sq. ft. from 80° to 212° F. with 5 lbs. of heating steam. But a baffle heater in the Islands is reported as heating 124 lbs. of juice per sq. ft. per hour with steam at 6 lbs. pressure and juice temperature from 90° F. to 217° F.

The work done by heaters is indicated by the number of B. T. U.'s transmitted across a sq. ft. of tube surface for each degree temperature difference per min. and is known as the heat transmission coefficient. The following table gives the old standard heaters at 70 lbs per sq. ft. per hour and the results from the above mentioned baffle heater. M is the mean temperature difference, and B the B. T. Units per min. per sq. ft. B/M the heat transmission coefficient, the juice density being at 65·5 lbs. per sq. ft specific heat = 0·9.

	Pressure of Steam Lbs	M	B	$\frac{B}{M}$	Speed through Tube Ft per Sec	Lbs Juice per Sq Ft per Hour
Standard heater	5	58·5	138·5	2·36	5 00	70
Baffle heater	6	53 4	236·0	4 42	4 96	124

Selection of Heaters

The accompanying table relating to baffle heaters will be found useful in selecting new apparatus and when considering the changing over of old heaters to baffle type The diameter of the shell in the first column gives choice of different numbers of tubes per pass to suit juice tonnage. The table is based on a speed of 5 ft. per sec. in the 22-pass heaters, the juice passing through the tubes in 66 secs. This time is kept constant for all the heaters, the juice speeds varying with the number of passes, the tonnage with the passes and tubes per pass.

Dia of Shell, ins	No of Tubes per Pass	No of Passes	Sq Ft Heating Surface		Tons Juice per Hour	Speed, Ft. per Min
			Inside Tubes	Outside Tubes		
31	3	16	258	282	13·2	3 63
33	3	18	290	318	14·8	4·10
36	4	20	430	471	21·9	4 55
39	4	22	473	518	24·1	5 00
42	5	22	592	648	30 1	5 00
45	6	24	775	848	39·5	5·45
48	6	26	839	919	42·7	5·91
48	7	22	829	907	42·2	5 00
48	8	20	861	942	43·8	4·55
48	8	22	947	1037	48 2	5·00
51	8	24	1033	1131	52·6	5·45
54	7	26	979	1072	49 8	5·91

Copper tubes 1¼ in. O. D. No. 16 Stubb's gauge, 15 ft. long. Lbs. of juice per sq. ft. per hour, 102

The lbs. of juice per sq. ft. per hour are 102 in all cases. If, in the heaters where the speed is 5 ft. per sec., it is assumed that a steam pressure of 5 lbs. gauge will heat the juice from 80° F. to 212° F., then the mean temperature difference is 58·5 and the B. T. Units per sq. ft. per min. are 203, giving a heat transmission coefficient of 3·47.

Assuming heat transmission coefficients to vary as the cube root of the juice velocity, a curve may be plotted giving heat transmission coefficients for juice velocities from 3 to 8 ft. per sec. with 5 ft. per sec. and B/M = 3·47 as a base. By the use of these curves, the effect of a change in juice velocity from the assumed standard of 5 ft. per sec. can be found. For instance, the 8-tube per pass 26-pass heater has a table velocity of 5·91 ft. per sec. Suppose the heat transmission coefficient is 3·67; this divided into the B. T. Units per sq. ft. per min. of 203 gives a mean temperature difference of 55·4. It can now be calculated that with a juice temperature from 80° to 212° F., the steam pressure required will be 4½ lbs. gauge. If the 8-tube per pass 26-pass heater had 50 tons in place of 57, then the heat transmission would be 177 B. T. Units per sq. ft. per min. and the velocity 5·18 ft. per sec.

In the case of a slow velocity heater, when increasing the tonnage, the steam pressure will have to be increased. Taking the 7-tube 20-pass heater at 38·3 tons and 4·55 ft. per sec., increased to 50 tons and 5 92 ft. per sec., gives a heat transmission of 265 B. T. Units and a coefficient of 3 67, which is a mean temperature difference of 72·2, corresponding to a steam pressure of 8½ lbs. In this case the time of the juice in the heater is 50·5 secs.

Mill and Boiling House Installations and Machinery in Hawaii.[1]

By ARTHUR F. EWART.

Letters were addressed to a number of mill engineers asking for a list of new machinery that was being installed in their factories this year, and following are some of the particulars communicated:—

J. Lewis Renton, of the Ewa Plantation Co. stated that an electric magnet was installed behind the first nine-roller mill unit to remove iron from the bagasse blanket before entering the second nine-roller mill unit, being made part of the discharge roll scraper, and set at an angle of 45°. It was very successful in catching and holding practically all of the iron and steel passing this point. With the heavy tonnage at Ewa most of the damage to the rollers and the grooving from pieces of iron occurs in the second mill train. Boiler feed water regulators of the Copes manufacture were tried out on four of the boilers and gave such excellent service that they are to be placed on all of the high pressure boilers. One advantage of this type of regulator is its simplicity, the only working part being the boiler feed valve itself and the lever to it. A fusible disc type of low water alarm is being used also. Water meters were installed on the boiler feed, maceration water line, and the mud press wash-water line. These are very satisfactory and a great help in the work and control of the factory.

The milk-of-lime for liming at the mixed juice scales is now being circulated and mixed with an air lift operated by compressed air. While not as efficient mechanically as other means of circulation now employed, provided the other equipment is kept up mechanically, it probably pays for itself in cost of upkeep and average efficiency. An attachment to the cane scales on the empty car side has been tried out for the past several months, this being an automatic registering device which will give direct readings of from 0·5000 lbs., and has given such a good account of itself that an order has been placed for another for the full car scale.

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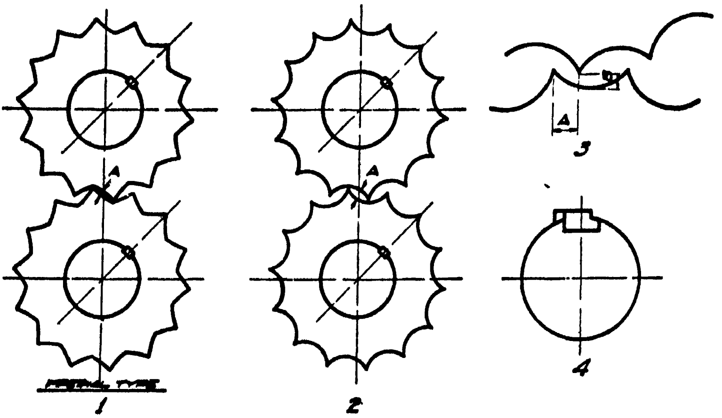
[1] Presented at Third Annual Meeting of Association of Hawaiian Sugar Technologists, Honolulu, October 27th. 1924 (and here condensed).

R. B. **Kay**, McBryde Sugar Co., Ltd., said that his only new installation was a Peck strainer, which gave very satisfactory results.

George Duncan, Olaa Sugar Co., Ltd., enquired why fuel economizers are not used, especially in places having a scarcity of fuel. Even in new factories their use is not suggested.

W. **van H. Duker** wrote: "The ordinary crusher roll consists of a shell fastened on a steel shaft; keying-up requires much time, this having to be done with the greatest care and accuracy, as otherwise it may happen that the shell works loose. The charges for putting on a new shell are often considered high, but when realizing the painstaking effort and skilful work required, it is clear that such work can only be done by expert and high-paid labour. The location of the keyway in the pinion on one roll is done after the keyway in the other roll has been fixed, because the pinion must be so fitted that the corrugations on the shell and the teeth on the pinion correspond in their relative positions.



METHOD OF TAKING UP WEAR ON KRAJEWSKI CRUSHER ROLLERS

"When the pinion has as many teeth as the shell has rows of corrugations, the key is placed opposite the centre of a tooth in such a way that the centre of the pinion tooth corresponds with the centre of the corrugations on the shell. The shape of the corrugations of the crusher shell has a decided influence on the quality of the crushing. In the illustration, the space lettered *A* over 1 and 2 is much smaller in the imperial type and the reabsorption of already removed juice is bound to be less. When the corrugations on the shell are badly worn, the distance *A* can be reduced by changing the position of the pinion teeth in relation to the corrugations on the roll; this is done by using an offset key in the pinion, as shown in the illustration. At Hamakua Mill Company, this was exactly the case. For years the extraction obtained with a crusher and 12-roll remained at about 95 per cent. Many suggestions were made, many improvements were executed, but the results were not changed. The crusher was badly worn and generally condemned until the local engineer, WM. CRAIK, shifted the pinion on the shaft in the manner described above. From that time on, entirely different milling results were obtained, i.e., an average increase in extraction of between 1½ per cent. to 2 per cent."

Mr. SEYMOUR TERRY discussed pressure evaporation, stating that on this system it is general to use three cells as a triple effect operating at about 16 lbs. pressure in the calandria of the first cell down to 1½–2 lbs. in the vapour side of the last cell. This steam from the last cell is used in the vacuum pans, which operate at vacuum, as at present. The amount of steam required by the pressure triple is, of course, more than would be used in a quadruple operating at vacuum; but, as it is discharged at such a pressure as to be of further use in the vacuum pans, a considerable steam-saving is made. In this way, a unit consisting of a pressure operated triple supplying steam to the vacuum pans shows a large decrease in steam consumption over a quadruple and pans both operating at a vacuum. This new method gives a higher steam temperature and a correspondingly higher syrup temperature. To avoid discolouring the syrup, rapid circulating evaporators having a high transmission coefficient are used so that the concentration is rapid, and the time the liquor is in the apparatus is short, which also means that the amount of liquor in the body at one time is much less than at present. Due to the condition that exists in syrup (in that as the temperature increases, the viscosity rapidly decreases), a higher rate of evaporation is obtained for a given temperature drop at the higher temperatures of operation in the pressure evaporator. Incidentally, the engines supplying the exhaust steam to the evaporators have to work against a back pressure of 16–18 lbs. per sq. in.

He also discussed vapour-compression as follows:—The heating steam enters the calandria of the first cell and the condensate is drawn off as usual. The vapour produced from the liquid in the body of the cell and which is at a lower temperature than the heating steam, depending on whatever temperature drop the cell is operated at, is taken from the top of the cell and put through a vapour compressor, where it is compressed up to the pressure and therefore the temperature of the initial heating steam. The methods employed to compress the steam may be: A motor-driven vapour-compressor; a steam engine-driven vapour-compressor; or a steam injector using live steam to compress the vapour. The greater the amount of work obtained from a lb. of steam, the lower the compression pressure, but this means a small temperature difference and large heating surface. The practical range appears to be about 7 lbs., or a temperature range of 12° F.

The Honolulu Iron Works Company recently made an installation of three large injector type compressors, also known as thermo-compressors, on the first cell of a quintuple effect for Los Mochis factory, in Mexico. The compressors were supplied with live steam at 100 lbs. gauge, and each lb. of live steam compressed 1·2 lbs. of vapour from 3 lbs. gauge pressure to 8 lbs. gauge pressure, thus supplying 2·2 lbs. of steam to the calandria. These 2·2 lbs. in the calandria would evaporate about 2·2 lbs. of vapour, so that 1 lb. of live steam resulted in the production of 2·2 lbs. of vapour, which is slightly better than a double effect pre-evaporator.

Our contemporary, *Sugar News*, quotes from an issue of the Hawaiian *Planters' Monthly* of 40 years ago, as follows:—"The maceration process was invented and adopted years ago, and although several of the planters here are thoroughly satisfied that double crushing will pay, and are adding two-roller mills to their three-roller mills, still it has not, as yet, been demonstrated to their satisfaction that it will pay for them to adopt the maceration process—that is, the use of water to saturate the bagasse in its passage from the three-roller to the two-roller mill."

Recent Work in Cane Agriculture.

THE WHITE GRUBS OF THE SUGAR CANE SOILS IN FIJI. *R. Veitch. Agricultural Report No. 5. Colonial Sugar Refining Co., Ltd. March, 1922.*

White grub is hardly a major pest in Fiji cane fields, but a description of its activities will be of interest to those planters elsewhere where damage by white grub is more serious; in Fiji there are great numbers in the cane fields, but natural conditions are present which inhibit any really dangerous activity. This comparative harmlessness is, in the main, traceable to white grub being indigenous in the islands; and it is thus living in its natural state, and has a considerable number of enemies. And this opens up the prospect that, in other countries into which it has been introduced, this pest will ultimately also become less of a menace, as soon indeed as the balance of nature is restored, and it reverts to its natural food, the humus in the soil. This bulletin is on a par with those already noted by the same author and maintains the high standard set by them.

There are three species of white grub attacking sugar cane in Fiji: *Rhopaea vestita* occurring on sandy soils, *R. subnitida* on red and alluvial, and *Adoretus versutus* on all soils; but the damage done by the first named alone is important and the bulletin is mainly devoted to it, although all three, together with the natural enemies of the first are illustrated on the four plates. The eggs of *Rhopaea vestita* are found in the sandy soils of the coast laid singly at the depth of 15-20 ins., being especially abundant in June and July: the period of incubation lasts on an average for 28 days, and practically all of the eggs hatch, although the number laid by each beetle is not more than about 30. The full-grown grub is about 1 in. long and a quarter broad, deeply wrinkled, and slightly hairy. The body is creamy white with the exception of the last segment, which is greyish, owing to the contents of the alimentary canal showing through: the head and its appendages are reddish orange, and the legs and stigmata a clay yellow. Most of the grubs are found at a depth of 6 ins. below the surface, in the cane fields usually underneath the stools. They also attack maize, but large quantities are found in abandoned fields, rendering fallowing useless in their control. Their food consists mainly of decomposed organic matter, distributed through the soil which they take in in very large quantities; living tissues only enter into this food in small proportion, but include cane roots; therefore, when they are present in large numbers, considerable damage may be done. They are specially injurious to young canes, one half to three quarters grown, from January to March, when they also attack shoots which they almost sever. Their presence is revealed by the yellowing of the leaves; the older plants suffer less, but the yield is decreased. The duration of this stage is from nine to ten months.

About April they enter the pre-pupal stage, cease feeding and shrink, while the greyish colour of the last segment disappears owing to the absence of ingested matter; they become sluggish and eventually prepare an unlined earth cell 6 to 18 ins. below the surface. After a couple of weeks they become pupæ and remain so for about 31 days during April and May. The pupa resembles the adult beetle, with the wings, wing cases and legs bound up in a sheath closely pressed to the body. The beetle when fully formed remains for 2-3 weeks in its chamber, hardening and darkening, and the most abundant swarming occurs during June and July. They hide during the day and emerge after sunset, noisily buzzing about posts, etc., for half an hour before feeding. Their food plants are the guava, palms, rain trees and sugar cane, but they do little damage. All the stages are passed through in about 12 months.

Rhopaea vestita has many natural enemies in Fiji, which, although the damage caused by it is serious enough, serve to hold it in check. It is readily attacked by various wireworms, the commonest being *Monocrepidius pallipes* which, like this white grub, only occurs in the sandy soils. It seizes the grub behind the head and extracts the contents of the body, and careful counts have placed the number of victims for each wireworm at 57 during the season. This wireworm does not attack the sugar cane and is therefore purely beneficial. Others less frequently met with also attack the cane, while any benefit derived from the sugar cane wireworm (*Simodactylus cinnamomeus*)[1] is wholly put into the shade by the damage which it causes to the crop. The large black and yellow wasp (*Discolia ovalauensis*) is an important factor in control. It digs into the ground, seizes a suitable grub and paralyses it with its sting; and then lays an egg on the abdomen of the helpless grub. This hatches, feeds on the body contents, and passes through its stages *in situ*, to emerge as a wasp in due course, which feeds upon the honey of flowers. Mites are found on the grubs chiefly in the laboratory and are not an important factor in the field. Lastly, mynahs destroy large numbers during agricultural operations.

Of control measures the most effective would be to delay planting until the end of April, when the grubs enter the pre-pupal stage; but the loss of the first four months with good rains and heat would more than counterbalance any advantage gained by this method. Collecting and destroying the grubs or beetles are not justified in the present condition of labour; although considered worth while at Labasa, where they are practised. Frequent ploughing would bring up large numbers for the mynahs which follow in the fields, but this would be agriculturally inadmissible in such sandy soil. Powerful lights attract comparatively few beetles, and these chiefly males. Impressed by the success which the author witnessed in Hawaii with the parasite *Scolia manilae*, broods were introduced into the island by him; but these have as yet not been met with in the fields. This, he notes, does not necessarily mean total failure, for the same thing occurred at first with *Ceromasia sphenophori*, and this has now appeared and is doing excellent work in Nausori. The bulletin concludes with short references to the other two white grubs of Fiji.

PRESENT KNOWLEDGE OF MOSAIC DISEASES. *Melville T. Cook. Journal of the Department of Agriculture in Porto Rico. VIII. 2. April, 1924.*

This paper commences with a brief summary of diseases of this type which appear to be of an allied character: yellows, curly leaf, leaf roll, mosaic. It is regarded as probable that such diseases, although only recently drawing much attention, may have existed for a long time. Peach yellows in fact seem to have been known in 1797, while the first definite record of a mosaic disease was made in tobacco in 1859, although this form was only studied and named mosaic in 1885. The peach disease occupied the stage for many years but, later, the name was extended to similar diseases in potatoes, tomatoes, sugar cane and other crops. Sugar cane mosaic was first recorded under the name yellow stripe in Java in 1890; it was noted in Egypt on imported Java canes in 1909, in Hawaii in 1910 and in Porto Rico in 1916. The present paper is a brief discussion of the various theories advanced from time to time as to its cause, which is still undetermined.

1. *Bud variation.*—This was suggested in Java, as the workers there failed to find any causal agent and also failed to transmit the disease artificially.

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[1] *I.S.J.*, 1925, p. 320.

2. *The soil theory.*—Although this has been held as the cause of the disease by a number of investigators, it is generally recognized now that the soil or any manuring or other treatment of it cannot be regarded as an actual agent.

3. *The bacterial theory.*—This was bound to come, with the development of bacterial knowledge. It was first advanced by MAY in 1886, and was supported by various other workers up to 1900. Some indeed claim to have discovered the causal bacteria, but no one has been able to give any definite proof.

4. *The protozoan theory.*—First advocated by IANOWSKI in tobacco, but without proof and not at the time attracting much attention. MATZ in 1919 found such bodies in diseased sugar canes, but later doubted their connexion with mosaic. KUNKEL in 1921 found protozoa-like bodies in maize, and later in sugar cane; but again was not able to offer any proof. NELSON in 1922 (?) found comparable bodies in tomatoes, but later studies revealed similar ones in healthy tissues. The author found protozoa in sugar cane affected by mosaic disease, together with profound differences between the cells of healthy and diseased plants. But it is not at present determined whether the bodies found are the cause or result of the disease.

5. *The physiological theory.*—At one time more generally accepted than any other, this theory was developed in connexion with the studies of the disease in tobacco. STURGIS in 1899 ascribed it to injuries, or to soil and atmospheric agencies. HUNGER (1903 and 1905) stated that the disease was the result of disturbed metabolism, which might be the result of meteorological or soil conditions. WESTERDIJK (1910) called attention to certain data which indicated that it might be due to the intensity of the light. While, however, it is very unlikely that any of these agencies can be looked upon as causative, their study must not be neglected, because of their influence on the severity of the disease. The soil appears to be connected with wheat mottle and wheat rosette, the temperature with potato mosaic, and moisture with that of the sugar cane; and all of these factors must therefore be studied with regard to the latter plant.

6. *The enzyme theory.*—This is closely associated with the last. WOODS found an abnormal increase in oxidizing enzymes in the diseased cells, with an excessive accumulation of starch and a defective transmission of the same; this was demonstrated by the author in peach yellows (and by the writer of this review in "spike" of the sandalwood); but does not offer a proof that the enzyme theory is correct. The author (COOK) is investigating the matter with regard to the sugar cane, and has found interesting physiological disturbances, which appear to be connected chiefly with the photosynthesis and metabolism of the plant. From the physiological standpoint, he regards cane mosaic as "starvation" induced by these disturbances, but their cause still needs elucidation.

7. *The virus theory.*—This was advanced by BEIJERINCK, who had previously held the bacterial theory; he explained mosaic by the presence of a "contagious living fluid," soluble, diffusable, and capable of increasing in amount. It is evident that mosaic disease can be transmitted from plant to plant; in tobacco merely by contact or even by the handling of diseased and then healthy plants; in some cases by pruning and in others by inoculation (COLEMAN has transmitted the sandalwood disease by grafting); in certain plants it is definitely passed on by insects. In some few cases it is transferable between plants of different species, and in others it is carried by plants without their showing its presence (the case of the POJ seedlings of Java will readily occur to readers in this connexion).

MOSAIC INVESTIGATIONS AT CENTRAL CAMBALACHE (PRELIMINARY REPORT). *Carlos E. Chardon. Ibid.*

Sugar cane mosaic was first reported in Porto Rico in 1915 from specimens obtained in the Arecibo valley ; and it is considered probable that it had already been present for several years, because of its widespread character in the fields. It rapidly became epidemic during the next five years, and by 1919 the whole island was invaded excepting the isolated valley of Yabucoa. More recently some considerable advance has been made in the control of the disease, partly by roguing, but more especially by the displacement of the old Cristalina and Rayada canes by the immune Uba and the resistant P O J seedlings derived from a cross between a north Indian variety and thick tropical cane. These latter are not however sufficient ; for in certain parts Uba has been found not to yield a dependable amount of sugar. This occurs, for instance, on the alluvial soils in the north east of the island, including among others the valley of the Arecibo. These valleys contain thousands of acres of excellent sugar land, but mosaic is widespread and is reported to have reduced the yield of sugar in a single year by one half, involving a calculated loss in one concern alone of $480,000. Uba does not succeed in rich alluvial soils like these, where the rains are frequent, and it has been discarded. The P O J varieties 36, 213 and 234 appear to be promising, but have not as yet had a fair trial, because of the "spectacular appearance of B H 10 (12) and S C 12-4 in the island, with their luxuriant vegetation and enormous yield of sugar, which seedlings promise to cover a wide area in the island during the next few years." These two canes are at present grown on about 700 acres in the Arecibo valley, and during the next year will probably cover practically all the alluvial soils of the Cambalache field. Roguing has never been applied here, and mosaic is widespread, some of the fields showing 80 per cent. infection. The whole situation thus requires careful consideration. In the first place it has been noted that the effect of mosaic on the two newly introduced seedlings is not nearly so disastrous as on most thick tropical cane varieties, and this is especially so in B H 10 (12). Their local behaviour has now been noted up to second ratoons, and appears to have been very satisfactory in spite of the high degree of infection. But will this resemblance to the P O J seedlings continue ? If it does not, their replacement, once they are the dominant forms, will entail a considerable loss ; and if it does, a bright future opens up for not only Porto Rico but possibly other countries similarly placed. The somewhat hasty generalization that all thick cane varieties are unable to withstand this disease may have to be reconsidered, and it is obvious that a more carefully worked out series of experiments is called for, before giving in to the necessity of planting inferior kinds like Uba. CHARDOÑ, in these circumstances, decided at once to open a nursery for the production of seed cane on a large scale, as a sort of reserve in case of disaster ; and on this nursery to conduct a series of varietal tests with as many kinds of cane of value as could be got together. But in the present full occupancy of the sugar cane lands and the prevalence of mosaic, the choice of site presented a very real difficulty ; and his solution of this difficulty is of sufficient importance to all interested in the disease, to be recorded somewhat fully, even though the results are of a preliminary character.

And here the author made use of an extremely interesting observation noted during field experiments on the southern coast of Porto Rico, and published in the 1921-22 Report of the Insular Experiment Station ; namely, that the percentage of infection in a heavily diseased area in the fields near to the sea was much less than in those further inland. To give actual figures, while the inland fields showed 90 per cent. of canes affected, those near to the sea shore showed 10 to 16 and, in one field, only 6 per cent. He there suggested that this might have something to do with the salt spray which would make the cane leaves unpalatable to the insect carriers, or indeed that the salt-loving plants of such areas would not afford the insects suitable food and would thus diminish their numbers. Be that as it may, a careful examination was made of a soil survey conducted on the north east coast in 1902, one of the maps of which is reproduced. There are three types of soil in the Arecibo valley : *A 1* on the map signifies Arecibo loam, a black tenacious soil of varying thickness, with yellow tenacious loam as subsoil. This is usually of poor agricultural value, but in places it is deep and rich, as around the Caño Tiburones near the sea (shark lakes ?). *As1* is the Arecibo silt loam which comprises the alluvial valley of the Arecibo river, one of the most important agricultural regions in Porto Rico : a rich brown loam of varying depth and uniformity, which is all planted with sugar cane for the Camabalache and Los Caños centrals, and affords excellent sugar cane land. *Ts* or Tanama stony loam occurs further inland, and is a tenacious red loam derived from tertiary strata as the result of weathering of the original limestone plateau : it is rather poor and usually placed under bananas, etc , but where communications are easy, also under sugar cane.

Sites for a possible nursery were selected in all of these and planted in March, 1923, to a considerable number of varieties which are now engaging attention in the island, the seed being obtained from the Insular Experiment Station. It was noted that in these varieties there was a great variation in the degree of infection, when grown for nine months and then examined ; but it was, as had been anticipated, remarkably low in the cane varieties grown on the Arecibo loam, thus corroborating the previous observation made on the south coast. Full details are given of the varieties planted and the treatment of the soil in each plot, with the amount of infection of each variety ; and averages are struck for the whole of the plants grown. In the Tanama stony loam the infection had reached 90 per cent., while the average for the Arecibo silt loam was 10·41, and for the Arecibo loam 1·67, the rate here varying from 5·61 to 0·72. The standard variety in this latter tract, which is regularly planted with cane near the lake, is the Yellow Caledonia ; and this variety was only infected to the extent of 1·12 per cent. Incidentally, it was noted that one Porto Rico seedling, P R 433, surpassed all others in yield and sugar content, but we note that B H 10 (12) is not in this list. The full report of this interesting experiment will be worth reading. It is stated that a large nursery has been started in the same locality, 26 acres in extent, and that at the time of writing, the infection was only 0·43 per cent.

CANE VARIETIES RESISTANT TO SALT LANDS. *F. S Earle. Ibid.*

This short paper, like the last, is in the nature of a preliminary report. On both coasts of Porto Rico there are various tracts of land too salty to permit of the growth of ordinary cane varieties ; and they are more frequently met with on the south side, where the climate is drier and irrigation is more common. Without proper drainage arrangements, such land is bound to become salty if not alkaline in due course ; and this appears to have been the case with lands formerly growing good crops of cane in these tracts. Before starting reclamation work, it became necessary to get some idea as to which kinds of cane were likely to prove more resistant, for it was already known locally that Uba and Sealy Seedling were more resistant than Cristalina, Yellow Caledonia and Cavengerie. Ninety-three varieties were accordingly planted in small plots of about 20 sets each, on land where Cristalina had failed completely. It is presumed from the context that the results given in the paper were obtained some six months after planting. As was to be expected, germination was slow and uneven (there is of course a tendency for salt to accumulate in the upper layers of soil, where evaporation exceeds rainfall, and the young shoots would be more sensitive to such conditions than those whose roots had penetrated to deeper layers).

After three weeks only 4 kinds showed as many as 20 shoots, 23 between 19 and 10, 27 between 9 and 5, 34 between 4 and 1, while four did not germinate. Some that had germinated most promptly and uniformly soon began to turn yellow and fail. At the time of writing, however, a number continued to show good colour and vigour; and it was observed that the seedlings from Demerara were more successful than those from either Barbados or Porto Rico itself. Among the last named, 41 seedlings were tested, and only 2 to 3 of these appeared to show satisfactory growth, and many were failing completely: a similar number were good among the 17 Barbados seedlings, while the 8 Demerara seedlings were quite good, with the exception of D 433. The author suggests that this success among the Demerara seedlings might have been expected, because of the low maritime sugar lands in that country, and seedlings would be thus tested for resistance where the soil would of necessity still be slightly salty, whereas the seedlings in Barbados and Porto Rico were raised on the uplands without reference to salt land.

At the time of writing, Bamboo Blanca, Penang, Rose Morada and Uba were the best of the older kinds: B 208, B 6536 and BH 10 (12) showed up best from Barbados; D 117, 448, 504 and 625 were quite satisfactory, while D 109, 350 and 1135 had equally good shoots, but an uneven stand; and of local seedlings PR 460, 11 (874), 18 (153) and 18 (171) still gave some promise, but PR 202, 207, 260, 271, 328, 417 and 449 were already complete failures. The final results of the experiment will be awaited with interest, as it is of considerable practical importance locally. (It is to be hoped that analyses of the juice will be made, as well as the total weight of canes, for from experience elsewhere it is known that cane plants grown on salty soils, while showing good enough growth, may have juice from which it is impossible to produce crystalline sugar. There appears to be a marked tendency for the common salt to be retained in the juice of such plants, not, it is true, as sodium chloride but as this salt of potassium, which inhibits the formation of sugar).

TASSELING. *O. C Markwell. Report presented to the Third Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, October, 1924.*

This paper may be taken as an addendum to the fuller one presented by **ALEXANDER** in the previous year;[1] and reprints, practically without remarks, reports received of observations sent in by several planters, with their respective views. The following appears to be the gist of these papers, although it is not always easy to get at the exact meaning of some of the "key" sentences.

W. C. JENNINGS, Hawi Mill and Plantation Company, deals only with mature or second year canes. He first made an effort to throw further light on the effect of arrowing on the juice of the cane, and had samples of four varieties, D 1135, Yellow Caledonia, H 109 and Striped Mexico, analysed in January, March and April, the time of arrowing being presumably about November. As a result, he found the juice uniformly richer in D 1135 canes which had flowered, and the exact opposite in Yellow Caledonia, while the results were uniform neither way in H 109 and Striped Mexican. These results will have to be somewhat modified when the counts of flowering are considered in the same varieties in the same fields. Yellow Caledonia flowered very rarely and the counts are not given: D 1135 had 82 to 94 per cent. arrowing stalks (5 counts): Striped Mexican,

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[1] Cf., *I.S.J.*, 1925, 14-18..

82 to 93 per cent. (13 counts): H 109, 90 to 99 per cent. (15 counts). **Details are also given of the vigour of the non-arrowing stalks and, invariably, these appear to have been thin or poorly grown.**

R. Penhallow made counts in December, 1923, on the arrowing of mature Striped Mexican (16), H 109 (16), Lahaina (6) and Yellow Caledonia (4), and certain other varieties with fewer counts. These were plants or ratoons, grown on mauka, ordinary elevation, and makai fields. To all appearance the amount of flowering on this estate is considerably less than on that referred to above, and the greatest variations occur all through. Striped Mexican varied from 27 to 70 per cent., H 109 from 29 to 79, Lahaina from 20 to 61, while Yellow Caledonia showed a uniform 5 per cent. (mauka only but both plants and ratoons). Occasional notes added, on H 109 and Lahaina, show that the parts of the fields under heavy cane gave the highest percentage of flowering.

As to immature (first year) cane, the author remarks that arrowing is usually regarded as undesirable because of decreasing the yield. Of the standard varieties, H 109 and D 1135 have the highest percentage of arrowing canes, while it is comparatively light in D 1135 and Striped Mexican. H 164 is the earliest, Badila is late and H 5001 seldom flowers. Penhallow sent the following observations made on November 3rd, 1923: D 1135 was flowering in all fields, Lahaina in some fields, Striped Mexican and H 109 showed a few flowers in some fields, Wailuku 4, 5, 11 and 13 very few. W 22 never flowers, and this is said to be the case with the Hawaiian variety Puaole.

The factors influencing arrowing are dealt with under a separate heading, and great diversity of opinion appears to exist. The results of Jennings' observations already given show quite conclusively that, under his conditions, the canes which do not flower are, in freely flowering kinds, generally thin or otherwise poorly grown; and this is corroborated by Penhallow, who sent in a number of observations on W 5 and W 9, makai and mauka grown; in all cases a low rate of arrowing is reported in places where the growth was poor or arrested. On the results of notes made on Yellow Caledonia grown under different conditions, he says "The canes had very good growth for their age. The fact that the cane grew so fast shows that a great deal of vigour was in the plants. When growing conditions became adverse, this vigour had to be turned to something else and the cane, already large enough, turned it to producing seeds."

W. W. G. Moir (Maui) takes, however, a different standpoint and supports his view by a number of examples, drawn from the varying treatment accorded to H 109 cane. His idea is that arrowing all depends on the regularity and evenness of the treatment, whether good or bad, during at least the three months previous to the usual flowering period. Any irregularity will at once induce flowering, whereas perfectly regular agricultural practice will inhibit flowering to a large extent. He thus believes that the extra arrowing seen along water-courses is due to the lack of regular treatment because, presumably, of the occasional flooding; Penhallow, on the other hand, puts it down to the additional growth of the cane, although this of course will be due to its particular environment.

Lastly, F. W. Broadbent (Maui) traces the influence of various doses of reverted phosphate upon the subsequent flowering of Yellow Tip canes at Koloa, on mauka lands 600 ft. in elevation. He gave doses of 0, 500, 1000, 1500 lbs. per acre, and observed corresponding percentages of arrowing of 33·7, 19·25, 8·00, and 7·16 respectively. He ascribes the heavy arrowing in the former cases to the stunting action of the smaller doses of manure.

C. A. B.

Efficiency of Filtration judged by Physical Tests.[1]

By K. R. LINDFORS, Michigan Sugar Co., Saginaw, Mich., U.S.A.

The methods at present used in sugar factory laboratories do not furnish reliable information in regard to filtration effectiveness of different kinds of filter presses or the improvement obtained by treatment with clarification processes and filter aids. Apparent and real purity are practically unaffected, and ash determination is of little value, as most of the material removed is organic.

It is here proposed to introduce rapid, uniform methods of physical examination and standards of visible and colloidal turbidity, and to report these, as well as the viscosity and surface tension, in terms conveying a definite meaning to the average practical sugar man. With the aid of physical tests it will become possible to check variations in the work, and also to express filtration effectiveness, including results obtained by different methods, in definite figures.

SURFACE TENSION.

Previous investigations by the author[2] and the careful work of H. S. PAINE and associates,[3] established the fact that surface tension furnishes the best available means for checking the removal of colloids or gums. DU NOUY'S surface tension apparatus permits the determinations to be carried out in a few minutes. Although the amount of gums removed by filtration is not regularly proportional to the increase in surface tension, it is undoubtedly better for practical control work and comparative purposes to express this increase as per cent. of gums, even if the relation between the two factors has not yet been accurately determined.

SURFACE TENSION AND ESTIMATED PER CENT. OF GUMS[4]

Surface tension Dynes	Gums Per cent.	Surface tension Dynes,	Gums Per cent
75·0	0·00	59·7	0·19
74·6	0·02	59·4	0·21
74·2	0·04	59·0	0·23
73·7	0·06	58·5	0·25
72·8	0·08	57·9	0·27
64·0	0·10	57·1	0·29
60·8	0·12	55·7	0·31
60·4	0·14	54·0	0·33
60·1	0·16	53·0	0·35
59·9	0·18		

Procedure.—Dissolve 26 grms. of granulated sugar, thick juice, syrups, and molasses, dilute to 100 c.c.; and determine the surface tension at 20°C., when the corresponding amount of gums are obtained directly from the table. Thin juices are tested directly without dilution.

As the depression of the surface tension varies with the composition of the gums, it is probably impossible to prepare a table giving accurately the relation between the two. Nevertheless, even the approximate figures given in the table have several advantages over the report of the result in dynes per cm., one of the chief of which is that it conveys a meaning to the practical sugar man, who probably does not know the significance of the scientific terms.

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[1] Presented before the Division of Sugar Chemistry at the 69th Meeting of the American Chemical Society, Baltimore, Md., April, 1925 (here abridged).

[2] *I.S.J.*, 1924, 315, 556.

[3] *I.S.J.*, 1925, 147, 210, especially Table VII.

[4] Table here abridged.

Viscosity Brix and Viscosity Purity.

"It is important to note that influence on viscosity is the immediate avenue through which the effect of hydrophile colloids is made manifest during factory operation. Increased viscosity diminishes the rate of diffusion and consequently retards boiling and crystal growth." The amount of these hydrophile colloids or pectins present in thick juice is ordinarily too small to be detected by the viscosity, unless the work is carried out with a degree of refinement impracticable in routine. In green syrups, second massecuite and molasses these impurities are concentrated to a point where their influence can be readily observed.

When only comparative results are required, a 100 c.c. pipette, enclosed in a glass tube through which running water passes to maintain a constant temperature, will serve. A pure sugar solution may be used to standardize the apparatus, the concentration of the sugar solution being determined by polarization By recording the results in the form of a graph the intermediate points can be directly found. The concentration or Brix corresponding to the number of seconds required to empty the pipette can be read without further calculation. For practical purposes it is suggested that this figure be directly reported as viscosity Brix, and all reference to centipoises be omitted. Thus, in the diagram a time of 140 seconds would correspond to 62 viscosity Brix. The polarization divided by the viscosity Brix gives the viscosity purity.

As the viscosity purity is largely independent of concentration, it furnishes a means of comparing syrups of different periods and from different plants. Important deductions can also be drawn from the relation of viscosity purity to the apparent purity. Normally the two purities should be almost identical: a higher viscosity purity indicates the presence of salts lowering the viscosity and comparative absence of gums; a lower viscosity purity shows that abnormal amounts of gums have accumulated in the syrup. Hence a decided increase in the viscosity purity on filtration is a proof of good performance. All viscosity determinations should be made at 20°C. or calculated to that temperature.

Turbidity.

Turbidity that can be observed by ordinary light is here referred to as "visible turbidity." The cloud appearing when a tube of the juice is subjected to the action of a strong narrow ray of light is called "colloidal turbidity."

Standard turbidity solution.—Rub 0·5 grm. of powdered anhydrous "Bentonite" with several portions of cool water in a mortar until uniformly mixed. Add 0·2 to 0·4 grm. of gum arabic, make up to 500 c.c., place in a shaking bottle, and shake vigorously for 10 minutes. Pour into a 500 c.c. graduate cylinder and allow to stand for 24 hours. Adjust a syphon so that the inside leg just reaches the 250 c.c. mark and draw off the supernatant liquid without disturbing the lower half. The solution drawn off is standardized in the Jackson turbidimeter.

Caramel solution.—Weigh out about 4 grms. of granulated sugar in a platinum or fused silica dish. Heat over a small flame until the sugar is completely caramelized, digest repeatedly with small portions of water on water bath until the caramel is completely dissolved, make up to 200 c.c., and mix. If the solution, diluted with ten parts of water, shows turbidity with Horne's turbidiscope (see below), it is filtered through a thick asbestos mat until absolutely clear.

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[1] Alexander, *Ind. and Eng. Chem.*, 1924, 16, 1140. "Bentonite" can be obtained from the author of this article.

Determination of visible turbidity.—The determination is carried out in the JACKSON turbidimeter, a 75 cm. glass tube (preferably inclosed in a brass tube of the same length) being used. The syrup is introduced gradually along the side of the tube by means of a large pipette until the flame of the candle underneath the tube can no longer be distinguished. The reciprocal of the depth of the liquid in centimetres multiplied by 100 gives the turbidity. Thus, a depth of 100 cm. corresponds to a turbidity of 1·00; 50 cm. to 2·00; and a depth of 13·7cm. to a turbidity of 7·30.

For the determination of the turbidity of juices too clear to be read directly, the following method is proposed:

(*a*) Pipette 100 c.c. of the standard turbidity solution into a 500 c.c. flask, fill up to mark with a 2 *N* (52·0 grms. to 100 c.c.) solution of cube sugar (filtered through asbestos if not absolutely clear), mix, and determine turbidity as above.

(*b*) Pipette 100 c.c. of the standard turbidity solution into a 500 c.c. flask, fill up to mark with solution to be tested, mix, and determine turbidity as before. If the turbidity of granulated sugar is to be determined, a concentration of 52·0 grms. sugar per 100 c.c. is recommended.

To obtain the turbidity of the juice, deduct the turbidity found under (*a*) from the turbidity of the juice mixture (*b*), and add one fifth of the difference (as correction for the dilution) to the difference.

Example: Suppose the turbidity of the diluted standard (*a*) to be 1·905 (52·5 cm. depth), that of the juice mixture (*b*) equal to 2·075 (48·2 cm.); then the turbidity of the juice is $0{\cdot}170 + \frac{1}{5} \times 0{\cdot}170$ or $0{\cdot}170 + 0{\cdot}034 = 0{\cdot}204$.

Determination of colloidal turbidity.—W. D. HORNE recently designed a simple turbidiscope[1] consisting principally of a black sheet-iron cylinder, inclosing a powerful electric bulb (200 to 250 watts). At the level of the luminous wire in the lamp there is a slit about 5 mm. wide passing all around the cylinder. A circular test-tube rack is attached to the cylinder. When a test-tube with juice is placed in the rack, the powerful electric light makes the colloidal particles in the juice appear like a luminous cloud, like dust in a ray of sunshine.

Dilute a part of the standard turbidity solution until it has a turbidity of exactly 5·00 (20 cm. depth in the JACKSON turbidimeter). One cubic centimetre of this solution diluted to 50 c.c. will then have a turbidity of 0·1. Prepare a set of standards by placing 1, 2, 4, 6, 8, and 10 c.c. in 50 c.c. NESSLER tubes, add sufficient caramel solution to impart approximately the same colour as that of the juice under examination, mix after filling up to mark, and compare with the sample to be tested.

Thin and thick juices are tested without dilution; of dark liquors such as green syrup and molasses, the normal solution (26 grms. to 100 c.c.) is taken and the result multiplied by 4. If the uniform slit were replaced by one of varying width, so that the openings in front of the tubes would be 1–1–4–2–2–5–3–3–4–4–5-5 mm., it would be possible to compare illuminated fields of varying thickness and thus check the relation to the standard found by dilution. Furthermore, such an arrangement would make it possible to compare a syrup before and after filtration and roughly determine the proportion of colloidal turbidity eliminated.

It saves time to prepare a 200 c.c. solution of double normal weight when testing wash syrup, green syrup, or molasses. Half of this volume can then be used for polarization by HORNE'S method, 50 c.c. for surface tension, and 50 c.c. for colloidal turbidity.

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[1] *Ind. and Eng. Chem.* (1924), **16**, 626.

Application.

With the aid of the foregoing methods the improvement obtained at a filter-press station can be definitely expressed as is shown in the following typical report:

	Before filtration.	After filtration.	Improvement.
Surface Tension:			
Dynes	54·4	62·1	7·7
Per cent. gums	0·33	0·11	0·22
Viscosity:			
Brix	65·1	59·1	
Purity	87·8	88·2	0·4
Turbidity:			
Visible	5 00	2·38	2·62
Colloidal	2·4	1·2	1·2

By comparing the improvement obtained with different types of filter-presses, cloths, or filter-aids, their relative value can rapidly be found. The rate of flow must also be taken into consideration, however, especially in judging the effectiveness of filter-aids.

Although further investigations of the tests herein described still remain to be carried out, this paper is now published in the hope that it may lead to a discussion out of which officially recognized methods, especially for determination of turbidity, will be developed. In the meantime the tests will aid in controlling the work in refineries as well as in beet sugar factories, and also help in solving perplexing problems of filtration.

Temperature and Analytical Changes in Sugar Liquor during Bonechar Filtration.[1]

By H. I. KNOWLES,

Atlantic Sugar Refineries, Ltd., St John, N.B.

The property of removing certain inorganic salts, in addition to organic matter, from impure sugar solutions distinguishes bonechar from other chars. The manner in which bonechar acts, however, is not fully understood; and consequently mysterious occurrences in the operation of bonechar filters are apt to be attributed to eccentricities of this otherwise admirable decolorant. To determine the cause of certain difficulties encountered in the operation of char filters, most refiners have at some time sampled and analysed liquor taken from different parts of a filter during operation. Some of the results of an investigation of this nature are herein presented.

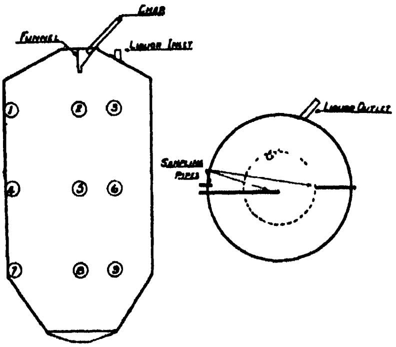

Figure 1.

A bonechar filter was equipped with nine sampling pipes, four of which carried resistance thermometers to the point of sampling. The arrangement is shown in Figure 1, which indicates also the manner of filling the filter with char. The char flowed through a funnel set in the mouth of the filter, and the cone of of char thus formed was levelled by hand every hour during the 10 to 12 hours required to fill the filter.

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[1] Presented before the Division of Sugar Chemistry at the 69th Meeting of the American Chemical Society, Baltimore, Md., U.S.A., April, 1925.

The distribution of char in a filter filled as described leaves much to be desired. The average sievings of ten samples taken, prior to levelling, at the centre and at the side of the filter are shown in Table I. The screen analyses were made on a sieve shaker with Tyler testing sieves.

Table I.—Grist of Bonechar in Filter.

	Side Per cent.	Centre Per cent.
On 16 mesh	31·7	20·0
On 24 mesh	37·8	30·6
On 30 mesh	21·5	21·8
On 35 mesh	4·3	5·8
On 50 mesh	3·7	8·2
Through 50 mesh	1·4	13·9

The larger amount of fines in the char taken from the centre section of the filter is typical of other tests. The results do not tell the whole story, however, for the fineness of the portion through 50 mesh is important.

The effects of char distribution on the operation of a filter are more conveniently shown when but one class of liquor is run on the filter. It was found that second liquor—in this case, liquor composed largely of twice-filtered wash syrup—showed more noticeably and perhaps more accurately the changes taking place.

The first effect of unequal distribution of char is noted during the settling period. Table II shows the percentage of colour removed from liquor sampled at regular intervals during the settling period near the bottom of the filter. Colour was measured by comparison with colour standards made from glycerol coloured with caramel.

Table II.—Per cent. Colour removed during Settling Period.

	Sampling Point		
	7	9	8
Hours from start of setting	Side Per cent.	Per cent.	Centre Per cent
2·75	76	93	96
3·00	76	96	
3·25	73	96	91
3·50	76	96	91
3·75	76	96	91
4·00	76	93	87
4·25	76	93	87
4·50	76	93	87

It will be noted that after contact of char and liquor there is no additional removal of colour. In the case of the liquor at the centre there is actually a decrease, or in other words, a production of colour. That this is due to temperature changes is indicated by the temperatures of liquor shown in Figure 2.

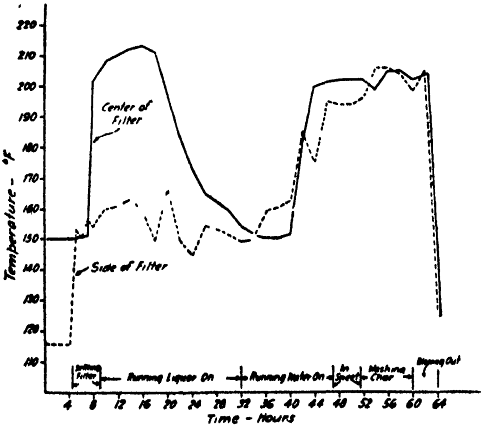

Figure 2.

Figure 2 shows temperature changes at Points 4 and 5 when filtering washed sugar; similar results have been obtained for Points 7 and 8 when filtering second liquor. In the test considered, char entered the filter at an average temperature of 150° F. (66° C.) and the liquor went on the filter at 160° F.

(71° C.). It will be noted that at the start, the char at the side was much cooler than the char at the centre, owing presumably to absorption of heat by the walls of the filter.

Table III shows a comparison of colour removed from liquor during a period of operation of the filter.

Table III—PER CENT COLOUR REMOVED DURING PERIOD OF OPERATION.

Hours from Start of Settling	Top 1 Side	 3	 2 Centre	Middle 4 Side	 6	 5 Centre	Bottom 7 Side	 9	 8 Centre
6	39	66	39	54	88	97	82	95	92
8	39	66	39	54	86	95	78	90	94
10	39	58	39	54	83	90	78	89	90
12	39	54	31	54	78	86	72	88	88
14	41	58	31	54	78	82	69	86	82
16	41	54	31	54	75	78	66	82	82

Evidently, liquor in contact with the char near the side of the filter is much less decolorized than the liquor from other points, with the exception of Point 2, where decolorization is no better. That this is also true of ash and organic matter removed at these points is shown by the results given in Tables IV and VI. One can understand why the coarse char, near the side of the filter, in contact with liquor at a lower temperature gives such comparatively poor results, but why the char at the centre near the top of the filter should give equally poor filtration is not easily explained Sievings of char sampled near Point 2 when charging the filter do not answer the question. The phenomenon has been noted in other tests, in which decolorization at Point 2 has sometimes been greater and sometimes less than at Point 1 The cause might be related to the air which escapes from the char in the centre of the filter after the surface has been covered with liquor It is probable that the combination of rising liquor and escaping air displaces fine char, leaving a coarser grist char than was originally present It is also possible that entrapped air interferes with the contact of liquor and char at this point.

In view of the differences in quality of liquor composing the total effluent, an estimate of the proportion of each is of interest Average samples of liquor leaving each of the three points near the bottom were compared with the total effluent for the corresponding period, with the results shown in Table IV.

Hydrogen-ion concentration was measured by Gillespie's drop method using a 20° Brix solution of the liquor.

Table IV.—COMPARISON OF LIQUOR IN FILTER WITH EFFLUENT

	Liquor before Filtration	7 Side	9	8 Centre	Average	Effluent
PER CENT. OF SOLIDS						
Sucrose	89 30	89 60	91 65	90 20	90·48	90 50
Invert	5 80	5 89	5 70	7·85	6·48	6·13
Ash	1 65	1·53	1 11	0·62	1·09	1·36
Organic	3·25	2·98	1·54	1·33	1 95	2·01
PER CENT REMOVED ·						
Colour	—	74·00	83 00	90 00	82·00	80 00
Ash	—	7·30	32·70	62 50	34 20	17·60
Organic	—	8·30	52·60	59·10	40·00	38·10
Glucose Ratio	6·49	9·57	6·22	8·71	7·16	6·77
pH	7·60	5 80	6 20	5·20	5·70	5·88

One might gather from these results that the liquor sampled from the side of the filter represents at least one-third of the total liquor delivered. This is again indicated by an examination of samples taken from the same points prior to and after the filter sent "in sweet." Table V shows how the finer grist char retains the sugar liquor during the "sweetening-off" period.

Table V.—Liquor from Filter prior to "In Sweet" and after "In Sweet."

	4 Hours before 'In Sweet'			3 Hours after "In Sweet"		
	7 Side	9	8 Centre	7 Side	9	8 Centre
Degrees Brix	38·20	39·15	46·25	0·60	1·55	3·30
Exponent	84·90	85·60	88·00	8·50	26·60	45·90

It is hardly possible to show analytical changes in liquor flowing through any vertical section of a filter, without assuming that the liquor travels at all points in the same direction and at the same rate. That such an assumption is not justified has already been shown. The comparison in Table VI, while not exact in every particular, is at least indicative of actual changes in the liquor. There is shown the analysis of theoretically the same liquor taken from different places in the filter The liquor preceding that tested was of somewhat higher purity, and this has probably influenced the results showing changes at the centre of the filter. The relative efficiency of the char of different grists is clearly indicated

Table VI—Analytical Changes during Bonechar Filtration.

	Liquor to filter	Side						Centre		
		1 Top	4 Middle	7 Bottom	3 Top	6 Middle	9 Bottom	2 Top	5 Middle	8 Bottom
Per cent Solids										
Sucrose	89·45	90·33	90·18	90·14	91·20	91·28	92·00	90·48	95·66	95·23
Invert	3·94	3·95	4·16	4·07	3·92	3·76	4·02	3·96	2·91	3·96
Ash	2·07	2·02	2·02	1·93	1·82	1·71	1·64	1·98	0·68	0·51
Organic	4·54	3·70	3·64	3·86	3·06	3·25	2·34	3·58	0·75	0·30
Per cent of Impurities										
Invert	37·40	40·80	42·30	41·30	44·50	43·10	50·40	41·60	67·20	83·00
Ash	19·70	20·90	20·50	19·60	20·70	19·70	20·60	20·90	15·70	10·70
Organic	42·90	38·30	37·20	39·10	34·80	37·20	29·00	37·50	17·10	6·30
Per cent Removed										
Colour	—	33·00	61·00	65·00	65·00	71·00	73·00	33·00	94·00	95·00
Ash	—	2·40	2·40	6·80	12·10	17·40	20·80	4·30	67·20	75·40
Organic	—	18·50	19·60	15·00	32·40	28·70	48·70	21·20	83·80	93·50
Glucose ratio	4·40	4·37	4·61	4·51	4·30	4·12	4·37	4·38	3·04	4·16
pH	7·60	7·30	6·90	6·70	7·20	6·80	6·60	7·60	6·30	6·20

A test was run to confirm the evidence that the grist of char was largely responsible for the filtration differences obtained. The same filter was filled by means of a rotating pipe directed toward the side of the filter. The char banked up against the side forming an inverted cone of char which was not broken down as was the cone formed in the other tests. Owing to interference of sampling pipe supports with the rotating pipe, the centre of the cone was nearer the pipes 3, 6 and 9. Sievings of the char from the side and centre are shown in Table VII, and Table VIII gives the analytical results of this test.

Table VII.—SIEVING OF CHAR IN FILTER.

	Side Per cent.	Centre Per cent.
On 16 mesh	20·3	44·9
On 24 mesh	29·8	36·1
On 30 mesh	22·6	14·4
On 35 mesh	6·8	1·9
On 50 mesh	10·0	1·4
Through 50 mesh	10·8	1·5

Heat, time, and hydrogen-ion concentration are three important factors influencing sugar losses during refining; and char filtration is probably the most important process in which they play a part. Inasmuch as each constituent of a sugar liquor is apt to undergo a change during char filtration, there is nothing to which the different constituents can be exactly related. For this reason sucrose losses cannot always be detected. In view of the high temperature and long time in contact of the liquor at the centre of a filter filled as first described, one might expect to find notable losses of sugar at this point. This is especially true when the liquor is of high test and of relatively low *pH*. An example of invert sugar destruction is shown in Tables VI and VIII; Table IV shows a loss of sucrose by inversion.

Table VIII.—COMPARISON OF LIQUOR IN FILTER WITH EFFLUENT.

	Liquor to filter.	In Filter— 7 Side.	9	Centre	Average.	Effluent.
PER CENT. SOLIDS:						
Sucrose	88·61	93·33	88·65	89·62	90·53	89·58
Invert	4·61	3·77	4·84	4·72	4·44	4·45
Ash	2·19	1·20	2·17	1·89	1·75	1·87
Organic	4·59	1·70	4·34	3·77	3·28	4·10
PER CENT REMOVED:						
Colour	—	86·00	61·00	72·00	73·00	66·00
Ash	—	45·20	1·00	13·70	20·00	14·60
Organic	—	63·00	5·50	17·90	28·60	10·70
Glucose ratio	5·21	4·04	5·45	5·27	4·90	4·97
pH	6·80	6·90	6·70	6·60	6·70	6·70

Tests have demonstrated, and experience has shown, that the *pH* of liquor from char filters is a valuable guide in protecting sucrose from inversion during char filtration. It has been found advisable to lime washed sugar liquor, if necessary, so that it will come off the filters with a *pH* of 6·8 to 7·0; while second liquor may have a *pH* as low as 6·5 without apparent loss by inversion. Usually, invert sugar is destroyed as a consequence of keeping liquors near the neutral point; it is a choice, however, of the lesser evil.

In view of the benefits to be derived from proper distribution of char, investigation of a means of securing this would seem worth while.

The Directors and Officers of the Fulton Iron Works Company have realized the importance of making adequate provision for extending terms to customers and for financing companies contemplating new factories or rehabilitating ones now in operation, and with this in view they have caused to be organized a new corporation under the laws of the State of Delaware, U.S.A., known as the Fulton Finance Company. This is owned by the Fulton Iron Works Company, and has a paid-up capital of $500,000 and an authorized note issue of $2,500,000, $1,200,000 of which is issued and outstanding. The formation of the Fulton Finance Company will, it is expected, enable the Fulton Iron Works Company to extend the credits which the nature of its business makes necessary, and it will also permit them to increase the scope and volume of business and render a greater service to their customers.

Suspended Furnace Arches for Bagasse Furnaces.

FUNCTION OF THE FURNACE ARCH.

The function of a furnace arch of refractory materials is to absorb heat up to the point of incandescence, and then radiate sufficient to ignite the fuel, and distil the volatiles. It has long been recognized that the underside of a "sprung or rounded" furnace does not present the ideal surface for securing complete combustion over a flat and even fuel bed. This type of arch does not radiate the heat rays evenly across the grate, with the result that combustion is often irregular and incomplete. Moreover, the furnace volume is restricted, being greater in the centre than at the sides.

FLAT SUSPENDED ARCHES.

Flat suspended arches are not new, patents having been taken out over 20 years ago for a certain type; but it is only within the last 6 or 7 years that designs have been developed which have proved their value in practical use and which have stood the test of time.

Among those designs which have come into general use and become well-known, the "Liptak" Double Suspension Arch, which has a main arch and a reserve arch of high grade refractory blocks, has come very rapidly into favour.

In the case of bagasse furnaces, it has been found that "Liptak" arches can be relied on to last over three or even four seasons without requiring repair, and when repairs become necessary, they can be done by unskilled labour in only a few hours.

It is also found that the bagasse burns as evenly at the side as it does in the centre, ignition is earlier and quicker, and that there is a very uniform flow of the gases to the tube heating surface, with more complete combustion due to the increased furnace volume. Further that the "Liptak" Flat Double Suspension Arch gives better service than a sprung arch, during the periods when oil is burnt either with bagasse or as a fuel by itself.

ADVANTAGES OF "LIPTAK" ARCHES.

(1) When a "sprung" arch requires repairing it generally has to be re-built, whereas a "Liptak" Flat Suspended Arch will last as long as the boiler, and can be repaired from time to time with renewable blocks and by unskilled labour.

(2) A "Liptak" Flat Suspended Arch gives increased furnace volume as the height at the sides is the same as at the middle, the refractories therefore not being so liable to burn out at the sides as they are with "sprung" arches. The radiant heat also is no greater at the sides than at the middle, so that combustion on the fuel bed is evenly distributed.

(3) With a "Liptak" Flat Suspended Arch the gases do not concentrate at the crown of the arch but are more evenly distributed in their passage upwards to the heating surface.

(4) Two or even three grates can be spanned by one "Liptak" Flat Suspended Arch and the brickwork removed from between the furnaces, giving maximum volume; or wider grates can be used without having any anxiety regarding the life of the arch.

(5) Instead of having to lay a boiler off for some weeks for rebuilding arches, renewable blocks can be inserted at a week-end and the boiler put into service again at once.

It is found that the savings effected due to the foregoing advantages soon recover the capital outlay for installing "Liptak" Flat Suspended Arches.

DURABILITY.

Flat Suspended Arches would naturally be expected to have a longer life than "sprung" arches, if only for the reason that flat construction eliminates all side thrusts from the refractories, and they are subjected to no strains except their own weight. But

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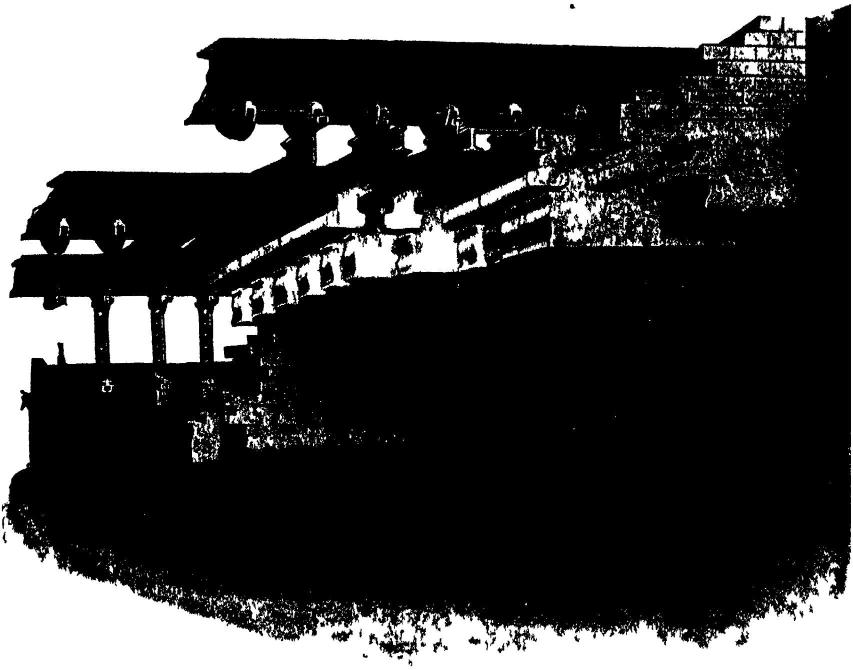
[1] Information regarding this invention will be furnished by The Sugar Manufacturers' Supply Co., Ltd., 2, St. Dunstan's Hill, London, E.C. 3.

owing to the fact that in the "Liptak" Double Suspension Arch, the steel and iron work is so thoroughly protected from the furnace temperature, and that the refractories composing the lower arch can be renewed a few at a time as may become necessary, these arches may be said to last as long as the boiler itself.

The actual period of time before which repairs to the refractories may be required depends entirely on the conditions under which the arch is working. With natural or induced draft very many cases have occurred where no replacements have become necessary for two or even three years and then only a comparatively few blocks required replacement.

General Construction.

The general construction of the Double Suspension Arch may be seen from the illustrations herewith. Steel beams of H-section are used to span the furnace; these are selected of ample strength to carry the arch without deflection and are left free at the ends. They are fitted on the lower flange with cast-iron brackets, carrying cast-iron hanger beams, from which the refractories of the reserve arch are supported. These refractory blocks in turn support the blocks of the main arch, which are provided with necks and projections to slide into the grooves provided in the construction of the reserve arch blocks. The necks and projections are amply strong enough to support the weight of the block, and do not break or crack in service.

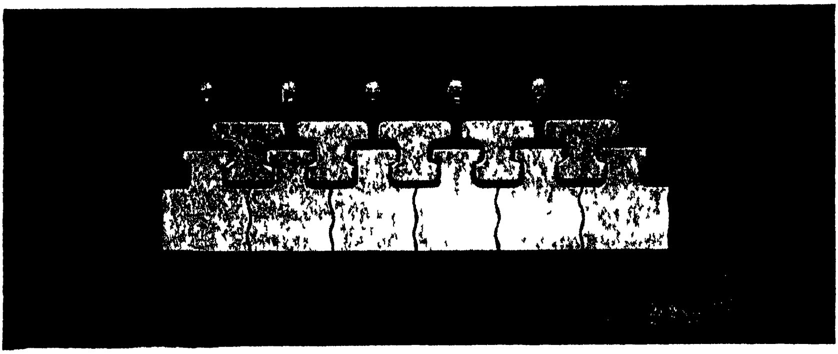


It will be noted that the blocks in the lower or main arch have waved line sides or flat corrugations which tend to prevent any block which becomes "spalled" or broken, from dropping out.

The two air spaces between the upper and lower blocks which are sealed at the ends, provide air insulation, thus materially assisting to confine the heat to the lower arch and preventing its transmission upwards. Air leakage through the arch is practically impossible and should a block in the lower arch become burnt away, the supporting framework is still protected from temperature effects by the reserve arch.

For this reason it is not necessary to effect repairs until the lower arch blocks are burnt away much further than would be safe in an arch having only a single row of refractories.

The high-grade refractory blocks used in the "Liptak" arch are made of the most suitable materials to withstand high temperatures and are burned from the finest grade of flint clay, by a special process which practically eliminates all shrinkage. They have a very low coefficient of expansion, do not disintegrate, and will successfully resist the highest temperatures. The blocks are designed to give the fewest possible joints.



"Liptak" Single Suspension Arches.

The "Liptak" Single Suspension Arch is supplied for cases where there is not sufficient room to fit a Double Arch or where the furnace temperature is low. *It has this great advantage, that any one block can be removed or replaced without interfering with any other block.*

"Liptak" Arches are in use in bagasse furnaces in a number of centrals in Cuba and elsewhere with the most satisfactory results. Their use, moreover, is now well established in large boiler plants in the U.S.A and this country for boiler furnaces and with powdered fuel.

Quotations will be made against enquiries and designs submitted either for new construction or for "Liptak" Arches to replace existing sprung arches. All enquiries should be accompanied by a blue print showing the present stoker and furnace arrangement and should state :—

(1) Particulars of the draft and amount of same.

(2) Particulars of the type of fuel normally burnt with—(*a*) Calorific value; (*b*) Percentage of volatiles; and (*c*) Ash content, if possible.

American Commerce Reports.

The 1924-25 Season in Hawaii.

Hawaii's progress during the past fiscal year was marked by unusual activity, notwithstanding certain adverse factors. The agricultural situation was saved by bumper crops, which offset to a certain extent the slump in prices for the island's two principal crops. New irrigation schemes have been commenced, inter-island shipping has been augmented, docking and warehouse facilities have been greatly increased, and the building programme has gathered considerable momentum.

A noteworthy move during the year was the employment of an expert to make an industrial survey of Hawaii. Although just inaugurated, it has already developed the fact that there are a great many openings in the islands for industries of various kinds which, when properly developed, should offer employment for a considerable number of persons as well as tend to lessen the island's economic dependence upon sugar and pineapples. Until recently almost 90 per cent. of the population was employed in the culture and preparation of these two products for the market, and development in other directions was neglected. As a result a crop failure or a slump in the price of sugar or pineapples affects adversely the entire community.

Although unusually large crops were realized during the year ended June 30th, the value of exports declined considerably from the preceding year, as a result of lower prices for the principal commodities, especially sugar. The value of exports to foreign countries and continental United States dropped from $106,212,651 during 1923-24 to $99,042,432 for the year ended June 30th, 1925. The share coming to continental United States fell from $104,549,651 to $97,627,432. This decline was accounted for almost entirely by a $10,000,000 drop in the value of sugar, notwithstanding a considerably greater volume of shipments, and would have been greater had it not been offset somewhat by a $2,000,000 increase in the value of canned pineapple exports. The value and volume of shipments of these two commodities to continental United States during the year ended June 30th, 1925, as compared with the preceding year, are shown in the following table:—

Items.	Quantity.		Value.	
	1923-24. Lbs.	1924-25 Lbs.	1923-24. $	1924-25. $
Sugar, "refined" ..	6,600,450..	14,900,020..	585,140..	981,152
Sugar, unrefined....	1,164,787,582..	1,357,442,499..	73,935,808..	63,632,662
Pineapples, canned..	297,965,685..	340,352,644..	28,247,410..	30,218,983

The preceding table shows that "refined" sugar exports were more than double those of the preceding year. With the further development of water power and its utilization in industry, it is probable that Hawaii in time will export the greater part of its sugar crop in the "refined" state instead of in the raw form as at present. The manufacture of molasses, a by-product of the sugar industry, appears also to be growing fast. Exports of this product to continental United States during the year reached 19,827,189 gallons, almost double the volume of the preceding year, and about 1·5 pints for each person in the United States.

TRADE IN SUGAR MILL MACHINERY IN SANTO DOMINGO.

In 1922 and 1923, the proportion of exports of sugar mill machinery to total exports of industrial machinery from the United States to the Dominican Republic was approximately 40 per cent. Last year this figure rose to about 65 per cent, indicating the growing importance of the sugar-mill machinery trade with this market. In 1924 cane mills valued at nearly $100,000 were exported to the Dominican Republic as was over $740,000 worth of miscellaneous sugar mill machinery, exclusive of centrifugals and cane and bagasse conveyors.

The table following gives United States exports of sugar mill machinery to the Dominican Republic for 1922, 1923, and 1924.

CLASS.	1922.	1923.	1924.
Cane and bagasse conveyors	$7,851	.. $21,908	.. $43,745
Cane mills	—	.. 40	.. 98,858
Sugar centrifugals	4,214	.. —	.. 5,423
Other sugar mill machinery	250,087	.. 345,363	.. 740,414
Total	$262,152	.. $367,311	.. $888,440

Mr. A. M. SIMPSON, a well-known business man in the P.I., recently stated that "some of the sugar centrals in the Philippine Islands have the right idea in meeting the present low price of sugar by installing more machinery, thereby increasing their production and lowering the cost of manufacture."

Publications Received.

Sugar. By Geoffrey Fairrie. Medium 8vo. xiv + 226 pages. (Fairrie & Co., Ltd., Liverpool.) 1925. Price. 12s. 6d.; post free, inland and abroad.

An introductory book on the science of sugar in general has long been desired by many, that is, a book which in non-technical language shall state simply and clearly the general principles and practice of modern raw sugar production and modern raw sugar refining. This book by Mr GEOFFREY FAIRRIE has been written with this purpose in view, its object as stated in the preface being "to present general information about sugar in such a form that it can be easily understood by the man-in-the-street" It will be admitted by those perusing this volume that the author has done well in realizing his aim He outlines the modern production of raw cane sugar, of raw beet sugar, and of direct consumption sugar, treats of modern refining, and describes the principles of the polarimetry and analysis of raw sugars, all in a very interesting way Further, he gives chapters on the nature of sugar, its elaboration by the plant, and its artificial production, on sugar and the human body, and on maple, palm and sorghum sugars, starch glucose, and invert sugar, and on statistics, each of which sections summarizes an amount of useful information, and broadens the scope of the book. Mr FAIRRIE has evidently devoted considerable care in conveying accurate information in the clearest possible language and we have no criticism to make regarding the manner in which he has done it A book such as this, written by such an experienced technologist as the author, is certain to be greatly appreciated by many, especially by the practical sugar man, who, not having had the advantage of a scientific training, finds the need of a work introductory to the volumes by DEERR, GEERLIGS, and others, the young student engaged in factory or refinery practice, by the business man interested in the industry who desires some insight into its operation, and lastly by the general reader. These, we are sure, will read Mr FAIRRIE's pages and examine his numerous original illustrations and flow-sheets with profit Technologists specializing in the manufacturing side should appreciate the lucid account of modern refining, and the refiner on the other hand the clear outlines of the producing branch of our industry All should peruse the chapter on animal charcoal and decolorizing carbons in which a quantity of useful up-to-date information on char application in the refinery and the possibilities of carbons is gathered together, and last, though not least, the author's essay on old-time methods (particularly in refining), the writing of which must have demanded not a little amount of historical research on the part of the author We highly recommend this book

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Jaarboek voor Suiker-Fabrikanten in Ned -Indië : 1922-25. [Year Book for Sugar Manufacturers in Java] (J H de Bussy Amsterdam, Holland).

This year this standard manual of Java sugar production appears in two volumes; and the useful amount of information it annually conveys is therefore now presented in an augmented form To all interested in Java and its important sugar industry, this "Jaarboek" is indispensable

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Jahr und Adressbuch der Zuckerfabriken, 1925-26 C. Artur Schallehn. (Albert Rathke, Magdeburg, Germany) 1925.

Rathke's well-known "Year-book" again presents a large amount of information regarding sugar production, particularly on the Continent. Its information is systematically arranged, and as a guide to beet sugar production in Germany, France, Belgium, Holland, Scandanavia, Czecho-Slovakia, Hungary, Poland, Italy and other countries, it may be well recommended.

Ingenieur-Kalender, 1926. Edited by Prof. P. Gerlack, in collaboration with others. In two parts, 48th year. (Julius Springer, Berlin). 1925. Price: 5 gold marks.

This is a standard pocket-book for the use of engineers. It contains a very large variety of indispensable data in a readily accessible form, and for those reading the language in which it is printed it is a valuable publication.

Sugar Cane Syrup Manufacture. H. S. Paine and C. F. Walton, Jr. Department of Agriculture, Bulletin, No. 1370. (Superintendent of Documents, Washington, D.C., U.S.A.) 1925. Price: 10 cents.

This is largely a compilation of data from various sources, though much new material, such as cost data, descriptions of model plants and apparatus, supplemented by sketches, and a comparison of the different methods of manufacture, is included. Problems of production, from the cultivation of the cane to the marketing of the syrup, are described; and several methods for clarifying the juice are stated in detail. Other matters treated are: The relationship between the cultural conditions under which sugar cane is grown and the quality and yield of syrup; the factors which determine the most economical size of a new syrup plant; and the prevention of crystallization by the use of invertase. Data on the composition, food value, and keeping quality of cane syrup are also given.

Die Weisszucker-Fabrikation in den Rübenzuckerfabriken. By Adolf Hinze. (Schallehn & Wollbruck, Magdeburg, Germany.) 1925.

Conditions in Germany are now such as to make a book on the production of direct consumption white sugar of interest, and no doubt this book will be of some assistance in supplying the want for information on the subject. It is divided into three parts, the first dealing with the theory of boiling massecuite, especially according to the processes of CLAASSEN and GRILL, the second with the yields to be realized by the application of four different schemes, and the third with combined raw sugar and "refinery" working. There are also appended sections on the production of loaf and cube sugars, in which the machinery generally used in such practice are described and illustrated. This book, though containing much data of interest, impresses one as being rather of a theoretical than of a practical nature. It commences with the boiling of massecuite, and throughout concentrates largely on the calculation of probable yields according to the well-known H-S formula, being less concerned with the conditions and precautions which must be observed from the earlier stages onwards for the production of good white granulated directly from the beet.

Ueber Entfärbungskohle im allgemeinen und über "Carboraffin" und "Norit" in besonderen. By K. Zert and Fr. Nosek. Tagesfragen aus der Zuckerindustrie, No. 2; edited by Dr. Oskar Wohryzek. (Albert Rathke, Magdeburg, Germany). 1925. Price: 3 gold marks (unbound).

This is the second of the new series of unbound booklets on "Questions of the Day in the Sugar Industry," which are being edited by Dr. WOHRYZEK.[1] It discusses in a good deal of detail the relative cost of application in the practice of the production of white beet sugar on the Continent of the two rival carbons "Norit" and "Carboraffin," the first of which is revivified, and the second of which relies upon its more powerful effect in obviating the necessity for such treatment. We refer those of our readers who are interested in this question at present being very keenly discussed in Czecho-Slovakia to the booklet, where they will find the conclusions of these authors, and their method of arriving at them.

Staub Explosionen. [Dust Explosions.] By Dr. Ing. Paul Beyersdorfer. With 14 illustrations. (Theodor Steinkopff, Dresden and Leipzig, Germany). 1925. Price: 5·50 gold marks (unbound); 7·0 (bound).

This is a booklet which will be welcomed in certain circles. It deals with the cause of dust explosions, such as may occur in sugar refineries and other industries, being an exposition of the author's now established theory, an outline of which has already been given in our columns.[2] We suggest that an English edition of this book on a subject which must keenly concern a large number of industrialists would be welcomed, in order to make its valuable conclusions and the method of arrived at them more widely available.

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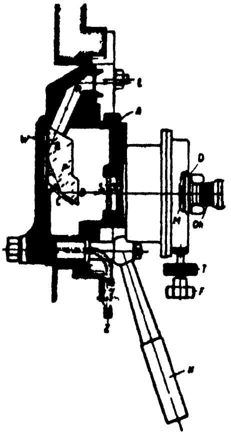
[1] No. 1 has already been noticed, see *I.S.J.*, 1925, 607. [2] *I.S.J.*, 1922, 573; 1923, 551.

Review of Current Technical Literature.[1]

A REFRACTOMETER WHICH CAN BE BUILT INTO THE WALLS OF VACUUM PANS, ETC.

F. Löwe. Vereins-Zeitschrift, 1925, 360-366.

Since 1906, when unsatisfactory results were obtained with an immersion instrument built into the wall of a vacuum pan, the firm of Carl Zeiss, of Jena, have been working on the elaboration of a refractometer, which, fixed into the side of a vessel, would enable observations to be made of its contents; but they now claim to have arrived at a satisfactory model. Light from a 50 c.p. lamp *L* is reflected from *R*, against the perpendicular surface of the prism *B*, which is in contact with the massecuite inside the pan or other vessel, the rays being again reflected from the surface *C*, and lastly through the ocular *O K* to the eye of the observer. By means of the screw *T*, the boundary line is adjusted so as to make the reading accord with the temperature, as indicated by a thermometer reading to 0·1° C (not shown). By moving the handle *H*, any crystals adhering to the surface *B* of the prisms can be removed, or they can be washed off by admitting water through the tube *Z*. As to the tables used correlating the refractive index and dry substance, for temperatures between 10 and 35° C., those of GEERLIGS[2] and STANEK[3] for 0 to 95° Brix are available; whilst for 25 to 75° C, and 0 to 75° Brix there are those resulting from the methodical studies of MILLER and WORLEY.[4] But for 70 to 100° C., and 70 to 97° Brix, special observations have now been made by Dr. H. ROCHOW, of Jena, using the new instrument. These, owing to their length, are not reproduced here. This refractometer makes it possible:—(1) to study the process of boiling massecuite in regard to pressure and temperature from the first to the last moment without taking a sample, and (2) to guarantee the process being operated in practice "without surprises," since the effect of each drink, and of each alteration of temperature or pressure on the concentration of the liquid part of the massecuite, can be measured with some accuracy, and without trouble (an observation taking little more than one minute).



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ADSORPTION OF CALCIUM FROM SUGAR LIQUORS BY ANIMAL CHARCOAL (BONEBLACK).

Jar Dêdek and O Langer. Zeitsch. Zuckerind. Cechoslov., 1925, 50, No. 1, 1-8.

In the early days of the scientific application of char, its quality as a decolorizer was soon put in the shade by its power of taking up mineral matter from the liquors, notably calcium salts, which phenomenon was observed to be accompanied by a decrease in the alkalinity. Later, when purer liquors were used in refining, some lime was added for fear of inversion previous to passing over char. Recently, however, when operating "Norit" pre-filtration in conjunction with bonechar treatment in the refinery, no lime was added, when it was found that the "natural alkalinity" of the liquors (namely that due to sodium, potassium and ammonium salts) was maintained without the occurrence of any inversion. Experienced gained in Czecho-Slovakia during three campaigns with this method of working without lime has proved that no change can occur, so that the question of unknown losses occurring as the result of sugar decomposition in work without lime must be answered negatively, provided always that these liquors possess a certain "natural alkalinity." Laboratory experiments have shown that the bonechar retains the calcium salts by adsorption, sodium, potassium and ammonium salts remaining in solution, the alkalinity due to these being therefore a stable one.

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[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] *I.S.J.*, 1901, 68 [3] *Zeitsch. Zuckerind. Bohm.*, 1908-9, 153. [4] *I.S.J.*, 1918, 379.

PREPARATION OF PERMANENT COLOUR STANDARDS FOR SOFT OR BROWN SUGARS.[1]

H. I. Knowles.[2] *Industrial and Engineering Chemistry, 1925, 17, No. 9, 980.*

For use by the refinery superintendent, the laboratory colour tester, or the centrifugal foreman, it is desirable to have a permanent set of colour standards for the soft or brown sugars, which themselves alter after a greater or less period of time. It was decided to use granulated sugar as a base, to colour it with powdered pigments, and to add sufficient Russian oil to give the mixture the characteristic soft sugar appearance. First, 2000 grms. of "coarse powdered" grade of granulated sugar are weighed into a wide, porcelain-lined dish; weighing bottles are filled with the pigments to be used (the weight of each being determined) and the sugar is dusted with some of each of the pigments, which are then distributed throughout the sugar. It is now necessary to test the coloured sugar in order to determine how closely it matches a real soft sugar which has been chosen as representing the average in colour. A small quantity of the coloured sugar is diluted with white sugar in a mortar and sufficient Russian oil is incorporated with the mixture to give it a wet appearance. Comparison is then made with the soft sugar. Pigments necessary to give the desired colour are added to the coloured "coarse powdered" and mixed in as before. This operation of adding pigments and making trial comparisons is continued until a close match is obtained between the real soft sugar and the artificial preparation. Then a set of standards is made from the coloured sugar by diluting a known quantity with a weighed amount of white sugar and adding a definite volume of Russian oil, incorporation of the ingredients being effected by a combination of grinding and mixing with a pestle. Whether the standard will have a homogeneous or a mottled appearance depends upon the thoroughness of the operation. To convey some idea of the amounts of the various ingredients used, the following details covering a set of standards that have been used successfully are given:—Pigments added (coarse powdered granulated, 200 grms.): Chrome yellow, light, 15·816 grms.; chrome yellow, medium, 13·498, yellow ochre, 6·098; raw umber, 3·739; ultramarine, 0·117.

Standards thus prepared and put up in square-faced glass bottles, provided with metal caps, have been in use more than six months. Under these conditions the only change noted has been a very slight reddening in colour, due presumably to the fading of the yellow pigments. This change, however, is not sufficient to require new standards. Tests indicate that at ordinary temperatures evaporation of the Russian oil is not appreciable, and therefore the standards could probably be kept in the tin boxes usually used for soft sugar samples.

DETERMINATION OF INVERT SUGAR [IN RAW BEET SUGARS].

R. Ofner. *Zeitsch. Zuckerind. Cechoslov.*, 1925, *49*, No. 36, 279-282.

If in HERZFELD's test (in which 50 c.c. of the clarified and de-leaded solution of raw sugar containing 10 grms, are mixed with 50 c.c. of ordinary FEHLING's solution boiled for 2 min., filtered, and the copper determined), there were present 7 mgrms. of invert sugar, this theoretically would correspond to 14 mgrms. of copper. Actually, however, the figure found by HERZFELD and given in his tables is 25 mgrms., which higher value is due to the products of superheating formed during the boiling process, which also have a reducing action. A means of obtaining a reduction due only to the invert sugar has been found by the author, this consisting in the use of a modified FEHLING's solution, prepared as follows: A solution of 20 grms. of copper sulphate in 100 c.c. of water at 60°C. is gradually added to a solution of 8·10 grms. of sodium carbonate (anhydrous) in 100 c.c. of water, also at 60°C., the mixture being well shaken until decomposition to an insoluble greyish blue basic salt with evolution of CO_2 has been effected. While still agitating the mixture, it is maintained for about 5 min. at 60° C., then giving after the evolution of free CO_2 a neutral or slightly alkaline reaction. Following this, 240 grms. of Rochelle salts (neutral) are introduced, and the temperature again raised to 60° C., a clear deep-blue alkaline solution thus resulting. In it are dissolved 80 grms. of sodium phosphate; this solution is once again heated to 60° C., washed into a litre flask, cooled, and made up to the mark. In using it for testing for the presence of invert sugar in raw beet sugars, 76·8 c.c. of the filtrate from a normal sugar weight solution, clarified with normal lead acetate, is de-leaded with a solution of secondary sodium phosphate and sodium oxalate, and the copper present estimated gravimetrically or volumetrically. Sucrose completely free from invert sugar is said to give no trace of cuprous oxide; whilst for every mgrm. of invert sugar not more than twice the number of mgrms. of copper are obtained. Amounts of invert sugar as small as 0·01 per cent. can be determined, it is stated, with certainty, and the reagent keeps well in dark glass bottles.

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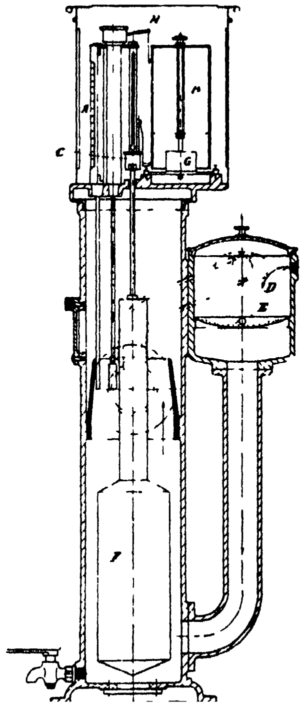
[1] Paper presented before the Division of Sugar Chemistry at the Baltimore Meeting of the American Chemical Society, 1925.

[2] Atlantic Sugar Refineries, Ltd., St. John, N.B.

Volquartz Automatic Density Meter for Evaporators, Char Cisterns, etc. *Communication to this Journal by the supplier of the apparatus.*



This apparatus indicates the changing density of any liquid passing through it, the variations being recorded by a pen on a revolving drum, thus to form a valuable means of obtaining a check on work done during day or night shift. Juice, or other liquid, is led into the receiver *D*, which is fitted with strainer, and is provided also with an overflow pipe for the removal of froth. It then passes down the vertical pipe through the bend and enters the main part of the apparatus, in which is found the large metal spindle or hydrometer *F*, this floating in the liquid, which slowly and uniformly rises and passes out through an over-flow at the side. Fixed to the top of the large spindle is a pointer carrying a pen *H*, which makes its record automatically on the revolving clockwork drum *B*, thus furnishing a density diagram for permanent record In this upper part of the apparatus (about 5 ft 7 in. high), which is enclosed in a glass case to guard against tampering, is a thermometer, and also a temperature correction scale giving the number of degrees to be added to the reading in order to bring it to normal density. In another somewhat more elaborate form of the recording device, a thermograph is included, this making a temperature curve on the chart just above the density curve. Volquartz' apparatus is of interest in cane sugar factories for controlling the density of the raw juice, and the juice entering or leaving the evaporators; in beet factories for diffusion juice, thin-juice, and thick-juice; and in the refinery for recording the density of the liquors going on the char.

Precise Determination of the Brix of Molasses. L. Johansen. *Archief, 1925, 33, No. 39, 1008-1010.*

Ordinarily when ascertaining the Brix of molasses, it is diluted, so that it is necessary (with the possibility of multiplying the error) to determine the density of this diluted solution with considerable accuracy. If dilution is ten-fold, an error of 0·1 becomes one of 1·0 Brix in the final result, an error which can hardly be avoided when using a Brix spindle. Much more certain results are obtainable by the picnometric method, but this demands some time, and is not well suited for routine work. Mohr's balance on the other hand gives a result easily, but the small "sinker" generally used hardly permits of a sufficient degree of accuracy. Its sensitiveness with a sinker weighing 10 grms., and having a volume of 10 c.c., may be taken at 0·1 per cent., whereas for a solution having to be multiplied ten times it should not be less than 0·01 per cent. But by the use of a much larger sinker and a sensitive sugar-balance (one weighing within 10 mgrms.), the accuracy of this method can be sufficiently increased to make a Brix determination with an accuracy of 0·008 per cent. In the absence of better apparatus, an electric bulb will serve well enough for the sinker, the metal fitting being removed, the wire bent into a small loop, and the hole in the neck filled in with sealing wax. Following this the pear-point of the bulb is carefully broken under mercury, and about 550 grms of the metal allowed to enter, this hole being sealed up in the blow-pipe. Then, the constant for this sinker is found, that is, its volume in Mohr c.c., by weighing it in air and next in water, the temperature of which latter is observed. If, e.g., it weighs 416·10 grms. in air, and 100·45 grms. in water with the temperature at 32° C. (corresponding to a temperature coefficient of 1·00367), the constant is 416·10—100·45 × 1·00367 = 316·81. In determining the specific gravity, the sinker is weighed immersed in the diluted molasses solution, the calculation of the result at 17·5° C. being: weight in air, minus weight in molasses, divided by the constant. Calculation may be avoided by constructing a table giving the Brix degrees corresponding to the weights obtained for the sinker in molasses.

DATA OF THE LA CARLOTA CENTRAL, P.I.

H. Gifford Stower. Communication to this Journal by the La Carlota Sugar Central, La Carlota, Negros Occ., P.I., dated July 16th, 1925.[1]

Commencement of crop, November 10th, 1924; termination of crop, June 7th, 1925; possible working days, 180; days of 24 hours, 174; days of 24 hours worked, 166; average of hours per working day, 22·11; average hours per day of 24 hours, 22·56; hours lost due factory, 94·39; hours lost due to want of cane, 85·24; based capacity of mills, 2000 tons; milled average for working day, 2390 tons; milled average for day of 24 hours, 2473 tons; milled average for 24 hours worked, 2592 tons; sacks of 126·8 lbs. produced for day of 24 hours, 5010; total sugar manufactured, sacks 871,782, tons 50,127; total cane milled, 430,238 tons, average purity crusher juice, 84 85; average fibre in cane, 11·07; tons of cane per ton of sugar, 8·58; total number of cars loaded, 112,479; average weight per car, 3·83; acres cropped, 22,135; average tons per acre, 19·4; hectares cropped, 8958; average tons per hectare, 48 03; average extraction by mills, 93·47.

RAPID ROUTINE DETERMINATION OF THE APPARENT PURITY OF SUGAR FACTORY PRODUCTS.

Franz Cahn. Die deutsche Zuckerindustrie, 1925, 50, No. 1, 19.

Into a tared metal beaker 30–50 grms. of massecuite molasses, etc., are placed, and the weight of the vessel and its contents ascertained within 0·05 grm. A weight of water equal to the weight of the contents of the vessel is added from a so-called "automatic" burette calibrated so that one division delivers 1 grm. at 20° C. After stirring (for 5 mins. with massecuites), the density of the liquid (thus diluted 1 : 1, or sufficiently so) is determined refractometrically or by spindling, working always at 20°C. Lastly, 25 c.c. are pipetted into a 100 c.c. flask, basic lead acetate solution and alumina cream added in sufficient amount for clarification, the volume completed to the mark, and the liquid mixed, filtered, and polarized. Using an extended Schmitz table here presented, against the Brix readings (corrected for temperature), a factor is given by which the polarization must be multiplied in order to give the sugar content, this being done by a calculating machine or by logarithms (the logs of the factors are given in the table), after which the quotient is calculated by the formula $\frac{F \times P \times 100}{2\,B}$, in which F is the factor from the tables; P is the polarization; and B is the Brix reading. This procedure, a modification of the German Customs method, is claimed to be "reproducible" to a high degree, besides being very rapid (one weighing only being necessary) and capable of operation by untrained assistants. It is now known as the "Rheingau" method, after the factory in which the author worked it out, and apparatus supply firms furnish an electrical apparatus for effecting the solution of massecuite in the cold, and accessory apparatus for carrying out the method with a minimum expenditure of time and labour.

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[1] For previous Reports of La Carlota see *I.S.J.*, 1923, 380; 1924, 501.

Review of Current Technical Literature.

DETERMINATION OF THE ASH OF SUGAR FACTORY AND REFINERY PRODUCTS BY MEASURING THE ELECTRICAL CONDUCTIVITY OF THEIR SOLUTIONS [ALTERATION OF COLOUR WITH HYDROGEN-ION CONCENTRATION]. *Harald Lunden.*[1] *Zeitsch. Ver. deut. Zuckerind., 1925, 763-778.*

Having determined the relationship between the electrical conductivity and the ash content of all the products obtained in his factory-refinery on both the raw and the refined sides, at concentrations between 0 and 70° Brix and at temperatures between 18 and 25° C., the author has drawn up a series of tables.[2] In these he uses the "ash quotient," that is the percentage of ash divided by the conductivity, this quotient being denoted by *K*. In particular he has studied the alteration of *K* with the Brix, so that, knowing the conductivity of a solution of a sugar product, the ash is obtained by multiplying by the corresponding value of *K*. Collation of these results shows that at fairly high Brix values the deviations between the *K*-values for solutions of different products on the raw side are very small, in fact at densities above 30° Brix one can accept when calculating the ash content from the conductivity the same values for *K* for molasses, affination syrups, massecuites, unwashed raw sugars, sweet-waters from the presses, and first and second raw sugars. But solutions of refinery products behave differently, the *K*-values for these being greater than those on the raw side of the same density, which relationship increases with increasing Brix. This difference signifies that the composition of the non-sugars in the two classes of solutions is not the same. There is another respect by which the two groups are differentiated, and this is the colour alteration from *pH* 11 (strong alkalinity) to *pH* 1 (strong acidity). In products on the raw side, the colour will be diminished by at most 20 per cent., whilst in those on the refined side this change is at least 50 per cent. Two different kinds of colours at least are therefore present, these being termed by the author "old colours," which predominate in products on the raw side and least altered by any change of the *pH* concentration; and "new colours," or those which have been recently formed during manufacture and which alter considerably by a change of reaction. In fact, one can decide whether a material belongs to the raw or the refined side by observing the extent of its alteration of colours with change in the *pH* from 11 to 1. In the routine altermination of the ash syrups and massecuites they are diluted with an equal weight of water (twice distilled), and the resulting solution is spindled and polarized as usual. Then the electrical conductivity is determined (at any concentration between 25 and 45° Brix), and the ash percentage read from tables here set forth.

SACCHARIN AS A PRESERVING AGENT. *Adolf Traegel.* *Vereins-Zeitschrift, 1925, 345-359.*

R. O. NEUMANN[3] not long ago reported experiments on the preservation with saccharin of certain preparations made with acid fruits, these having been found to keep for some time without any decomposition. But the present writer controverts the idea that this coal tar product can be regarded as a preservative, for such acid products, at least. Experiments are described with solutions of sugar and preserves made with apple pulp which could not be preserved with saccharin used in an amount as to be equivalent in sweetening power to the sugar ordinarily used, whereas the preservation was perfect in its absence. Saccharin decomposes during prolonged boiling in aqueous solution and more rapidly in acid solution, even in the presence of weak vegetable acids. Thus solutions of saccharin when boiled in the presence of acetic, tartaric and malic acids for duration up to five hours soon decomposed on cooling, whereas such sucrose solutions in the absence of saccharin remained quite free from mould growth during four months. Saccharin used in the ordinary way (without being submitted to the action of acids at boiling point) has an inferior antiseptic action, anyway when compared with benzoic and salicylic acid, 1·5 grms. having the same effect as 0·25 grm. of the latter, for example.

J. P. O.

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[1] Contribution from the Laboratory of the Svenska Sockerfabriksaktiebolaget, Gothenburg, Sweden. [2] See also *Centr. Zuckerind.*, 1925, 204.
[3] *Zeitsch. Nahr. Genussm.*, 1924, 47, 184.

Review of Recent Patents.[1]

Cane Cutter. *Harold V. Patten, Ernest C. Meeker, and Diego B. Toledo*, of Hilo, T. H. *1,546,550.* July 21, 1925.

General objects of the invention are (1) to provide a number of screw shafts for bringing the cane against the knives so that all the cane in the row will be cut regardless of the position of the stalks in the row; (2) to provide a plurality of knives which are yieldingly held and which are flexibly connected with each other. Fig. 1 is a plan view showing same attached to a tractor; and Fig. 2 is a section on line *2—2* of Fig. 1. In these views *A* and *B* indicate a pair of frames which are suitably attached to the front of the tractor *C*, the two frames being connected together by the bridge piece *1*. Each frame consists of a pair of upright members *2*, connected together by the rib *3*, and the shaft *4* which is provided with flanged bearings. A centrally arranged vertical rib *5* is connected with the part *3* of each frame and this rib supports the castings *6* through which the shaft *4* passes and which forms a housing for the worm gears *7* and *7*, one of which is located on shaft *4* and the other is slidably mounted on a vertically arranged shaft *8*. This has its lower end journaled in the central knife casting *9*, to which is secured the knife gear *10* and the gear *11* which meshes with the gears *12* of the knife castings *13*, these being located on each side of the castings *9*. These castings are recessed to receive the knife parts and the central casting carries the gears *14* which mesh with each other and with the gears *10*, the front one of which having the disc knife *15* secured to its axle so that the knife will be rotated through the gears and shaft *8*. Each of the side knife castings *13* carry the sprockets *16*, the rear one of which is connected with the gear *12* and an endless chain *17* passes over these sprockets so that the movement of the rear sprocket will be communicated to the front sprocket. This front sprocket has secured to the lower end of its shaft a disc knife *18*. The side castings are of greater length than

Fig. 1.

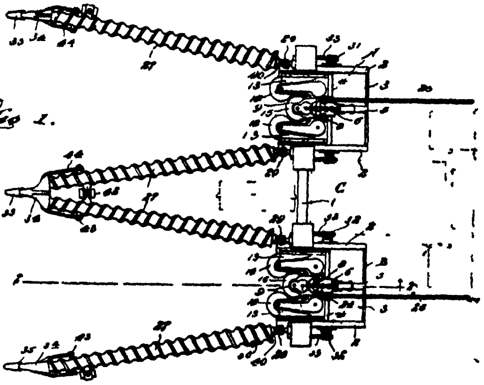
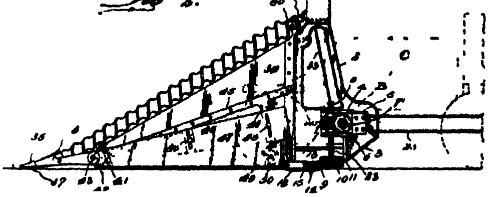


Fig. 2.



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[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W C 2 (price 1s each) Abstracts of United Kingdom patents marked in our Review with a star are reproduced from the *Illustrated Official Journal* (*Patents*), with the permission of the Controller of H.M. Stationery Office, London Sometimes only the drawing or drawings are so reproduced. *United States* Commissioner of Patents, Washington, D C (price 10 cents each) *France* · L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany*: Patentamt, Berlin Germany.

the middle casting so that the side knives are arranged in advance of the middle knife, as shown in the plan view. The knives are bevelled on the bottom sides from the centre to the cutting edge so that they will have a tendency to ride on top of the ground instead of digging in. The centre casting is hinged to the side castings by the hinges *19* and the side castings are connected by the hinges *20* with the side plates *21* which are pivotally connected with the uprights *2*, as shown at *22*. This arrangement of parts will permit the knives to rise and fall with the ground and the centre knife is yieldingly held in contact with the ground by means of a spring *23* on shaft *8* which has its upper end bearing against the bottom of casting *6* and its lower end against the gear *11*. Upper part of the shaft *8* is preferably of hexagon shape and this part of the shaft works in a similar shaped bore of the gear *7*. The gears *11* and *12* are shaped as shown so that the gears will remain in mesh at any angle that the knife castings may take This arrangement of the knives and their associated parts will permit the knives to cut the cane growing out of the tops and sides of the rows. Shafts *4* are driven from a part of the tractor by means of the sprockets *24* and the chains *25*. In order to bring the canes to the knives, a pair of screw shafts *27* for each set of them is provided These shafts are each formed of a wooden screw having a shaft *28* passing through the same and the upper end of the shaft is connected by the universal coupling *29* with a shaft *30* which is geared to a shaft *31* which is connected by the sprocket *32* and chain *33* with the shaft *4*. The lower end of each shaft *28* is rotatably supported in a shoe *34*, the central shoe being formed double to receive the ends of the central pair of conveyors which are convergent from the frames *A* and *B*. A slipper *35* is slidably supported on the end of each shoe and is held in its projected position by a spring *36* Each slipper carries a roller *37* for engaging the ground. If this slipper should strike an obstruction the spring *36* will act as a shock absorber to prevent damage of the parts and will return the slipper to normal position after it has passed the obstruction. A vertically arranged plate *38* is arranged under each conveyor, said plate being of tapered formation and has its wide end connected with the frame *2* by the slot-and-pin connexions *39*. Each plate is also connected with the shaft *28* by the bearings *40* The outer end of each plate carries a casting *41* which supports a roller *42* and the pin *43*, said pin passing through the arms *44* which are connected with the shoe. As shown, the casting for wheel *42* of the inner pair of plates passes from one plate to the other so that the wheel is located between the two plates. The wheels on the outer device are located to the outer side of each plate. A reinforcing strip *45* is secured to the bottom of each plate and has a depending part *46* to which a bottom plate *47* is adjustably secured by the bolts *48*. This bottom plate has its front end pivotally secured to the front casting *41* and has a bracket *49* adjacent its rear end which supports a roller *50*, this roller engaging the ground. It will be seen that each plate *38* will move with the conveyor due to its slot-and-pin connexion with the supporting frame so that the conveyor assembly can ride over the ground. The bottom plates *47* will remain close to the ground at all times so that all the canes will be forced against the knives. This invention will cut the cane regardless of the angles the stalks grew in. The conveyors will direct all the stalks against the knives and the inventors may provide suitable means for receiving the cut canes from the knives. The arrangement of the conveyor parts will permit the device to be used on unlevel ground.

CLARIFICATION OF CANE JUICE, USING DYE-MORDANTS, AND REVIVIFYING AND UTILIZING SAME. *John C. Hebden* (Assignor to *Hebden Sugar Process Corporation*, of New York). (*A*) *1,545,320* July 7th, 1925. (*B*) *1,545,321*. July 7th, 1925. (*C*) *1,545,322*. July 7th, 1925.

(*A*) In an example of this method of revivifying dye-mordants used for clarification,[1] the activated substrate carrying the impurities which have been fixed and absorbed in the process of purification is suspended in boiling water, to which has been added or may be added sufficient mineral acid to hydrolyse the impurities, or sufficient of the salt of a metal which will react as a weak acid to perform the same hydrolysis. As the amount of the impurities to be hydrolysed varies, the strength of the acid or salt solution used may be varied accordingly, trial showing in each case whether the acid or salt solution is too strong. If the acid or salt solution is too weak, some of the impurities will be left unhydrolysed; whilst, if it is too strong, some of the activated substance will be decomposed. After the whole mixture is boiled, the product may be filtered and washed, and is then ready for re-use; or the acid solution may be neutralized before washing and filtering; or again the acid or the neutralsolution may be treated with a small percentage of the original amount of tannic acid used for making the original dye mordant or subtrate, the product thus obtained being filtered and washed ready for re-use.

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[1] U. S. Patent, 1,545,318.

(*B*) In the method previously described[1] for purifying the raw cane juice the nitrogenous substances are absorbed by the dye mordant or the activated substance and are at the same time coagulated by the action of the heat, so that one obtains from the raw juice a product which can be used for the building up of a reagent similar to or equivalent to the synthetic fibre or gelatine-tannin compound previously described. In order to take advantage of this discovery, all that is necessary is to treat the precipitate formed by the method described for the use of the dye mordant, or the activated substance in purifying raw sugar juices, which precipitate carries the combined dyestuffs and absorbed impurities, (gums, polyphenols and precipitated albuminous substances) with the salt of a metal, as for instance, sulphate of alumina, ferric sulphate or titanium sulphate in a boiling solution, whereby the coagulated and precipitated nitrogenous substances are hardened just as any other albuminous or gelatine-like substance would be hardened by treatment with similar salts of metals, and the absorbed and hydrolysable impurities are rendered soluble. As the amount of the impurities will vary, so the amount of salt to be used will vary too, hence no definition of the amount of salt to be used can be given, this being determined in each case by trial. If the amount of salt used is insufficient, some of the impurities will be left unhydrolysed, and if it is in excess of that required to hydrolyse the impurities, some of the activated substance will be decomposed. Excess of the salt of the metal used can be then neutralized with any alkali which will precipitate a hydroxide, and there is present in the re-generated dye mordant or substrate an insoluble metallic hydroxide and a nitrogenous compound, both of which will combine with tannic acid and yield a quantity of active material for purifying the raw juice when the same is treated with the recovered and re-generated material obtained after this method. In utilizing the nitrogenous substances contained in the juice in this way, the advantage is that not only is a waste product converted into a valuable purifying material, but in addition the nitrogen fixed can be recovered to be available as fertilizer, thus increasing the economics of the general process. As the quantity of recovered substrate or activated substance or dye mordant plus the increment of insoluble nitrogenous or albuminous substance accumulates, the excess not required for treating the regular run of juice is discarded and is thus available as fertilizer.

(*C*) All the impurities taken up and removed from sugar juice by the mordant or the activated substrate made from the insoluble hydroxide or the tannate of the metals, are readily acted upon by strong alkaline solutions, whilst the inorganic compounds used in the preparation of the substrates are re-precipitated or re-generated by these alkaline solutions, as hydroxide. Thus it is possible to recombine these hydroxides with tannic acid and similar compounds by adding a fresh solution of tannic acid or any suitable tannin set forth above in the description of the method of making the original substrate. Strong oxidizing reagents in alkaline solutions will decompose the impurities taken up by the substrate and the insoluble hydroxide can be re-generated therefrom. Any strong oxidizing reagents can be used, such for example, as an alkaline solution of hydrogen peroxide or a hypochlorite or "similar oxidizing compound." Strong acids, as for example, sulphuric or hydrochloric acid, may be used to dissolve the hydroxide component of the activated substance on the substrate, and this can be re-precipitated, using a caustic alkali for precipitation, thus causing the impurities, as well as the substances combined with the hydroxide to remain in the solution. Hydroxide thus precipitated upon the substrate can then be recombined with the tannic acid. An oxidizing agent such for example, as a soluble chlorate or similar compound may be used in connexion with an acid solution for decomposing the activated substance and the impurities on the substrate. By re-generating the substrate, as is made possible by the present invention, there is the saving of the cost of the original insoluble base or material upon which the activated substance is precipitated, and when insoluble tannates are employed as the activated substance or mordant, there is an additional saving of the cost of the hydroxide used.

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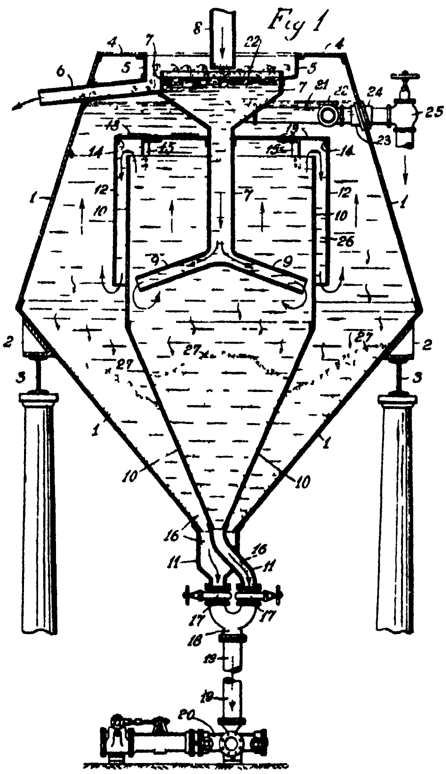
[1] U. S. Patent, 1,545,318.

CONTINUOUS SETTLING TANK. *Frank J. Casablanca* and *Manuel F. Galdo* (Assignors to the *Continuous Clarifier and Settler Company*, of Havana, Cuba). *1,542,666*. June 6th, 1925.

An apparatus of continuous action operates in such a way, that, due to its lower density, the clear liquid will flow out above and the settled impurities below. Separation of the impurities are obtained by causing the liquid to change its direction and velocity of flow several successive times, preferably reducing the velocity on its upward motion (that is, against the action of gravity) and increasing the velocity on its downward motion (or with the action of gravity). This apparatus has decided advantages over the now known clarifiers or defecators due to its simplicity of construction and action and economy effected by its use.



It consists of a tank or outside body *1*, in the shape of two truncated inverted cones joined together; the lower cone forming the bottom being provided with brackets *2* for support on beams *3* of a suitable platform or staging. The upper cone is covered with a flat plate *4*, rivetted to its upper border and and having a large central opening, through which it is rigidly joined to a circular body *5*, whose bottom slopes down towards one side, and having connected to its lowest point an inclined tube *6*, which projects out through wall of tank *1*, this body *5* thus forming a trough around a funnel-shaped receptacle *7* whose upper edge is higher than the bottom of trough *5* Inside this receptacle, the tube marked *8* discharges the turbid liquid to be clarified, e.g., juice already limed and heated to near the boiling point. Funnel *7* is provided with a long downtake tube *7'* which reaches down and then branches into opposite sloping discharge tubes *9*. Forming an intermediate body between outer tank *1* and downtake *7'* is located a cylindrical tank with conical bottom *10*, so that the ends of inclined tubes *9* are quite close to its shell. The conical bottom of this tank *10* is concentric with conical bottom of outer tank *1*, both connecting with a 2-passage piece *11*, as it will be explained later. Around the cylindrical body of tank *10*, and at a short distance from it, is arranged a cylindrical bell *12*, closed on its upper end by cover *13*, which allows the passage of and is rivetted to downtake tube *7'*, through flange *14*, and from which tank *10* is also supported or suspended by means of several angle plates *15*. The special piece *11* has two passages, the outside one *16* connecting to the mouth of conical bottom of outer tank *1* and the other passage *16'*, connecting to the mouth of conical bottom of inside tank *10* ; both passages *16* and *16'* being provided with valves *17* and *17'* and joining to a Y, *18*, which connects through pipe *19* to a magma pump *20*. In the upper part and inside tank *1*, there is an arrangement consisting of a bent tube *21*, placed horizontal and more or less level with border of funnel *7*, provided with several intakes *22*, in which the clear juice overflows and is let out of the apparatus, tube *21* being connected through a short nipple *23*, with another tube *24*, outside of tank *1*, and provided with controlling valve *25*.

This settler works as follows: Turbid juice, previously limed and heated to almost 100°C. is discharged through the pipe *8* into the centre of funnel *7*. The foam formed by the liquid falling on the surface of the liquid in the funnel overflows over the top of the funnel *7* and falling in the trough *5*, flows out through tube *6*. The liquid or juice descends through tube *7'*, discharging through the inclined tubes *9* into the inner tank *10*, until this is filled and then overflows over its upper edge and descending through the circular space *26*, formed by tank *10* and bell *12*, falls into the outer tank *1*, and filling this, the clear juice already clarified overflows into inlets *22* and out through valve *25*. The mud formed by the precipitated impurities on the conical bottom of tanks *1* and *10*, falls out slowly through the spaces *16* and *16'* of special piece *11*, their discharge being controlled by the valves *17* and *17'*, then, falling through Y *18* and pipe *19* to magma pump *20*, it is sent to the mud tank or other place, according to the system used by the factory. When working the defecator is always completely full of liquid When this liquid falls into tanks *10* and *1*, the heavier substances (forming the mud) fall to the bottom. This effect is assured and increased in two ways: (1) by the changes of direction which the liquid is forced to take ; that is, after falling into tank *10* through tubes *9* it flows upwards until the edge is reached, then moving downwards until reaching the lower edge of bell *12* it flows upwards again through tank *1* ; (2) by the changes of velocity which the liquid suffers during its course through the apparatus, due to the difference in the area of the passes leading up and those leading down, the downward passes like tube *7'* and space *26*, having an area a great deal smaller than the upward passes, such as tanks *10* and *1*. Due to the very low velocity of the liquid in the relatively large sized tanks *1* and *10*, plenty of time is given to the heavy particles to fall to the bottom, thus clarifying the liquid.

DEHYDRATED MOLASSES (BLACKSTRAP) PREPARATION. ***Stanley D. Wilkins*** (Assignor to ***H. C. Weiner and E. C. Gould***, of St. Louis, Miss., U.S.A.). *1,548,293.* August 4th, 1925.

While blackstrap molasses is of great commercial value in numerous industries, its use is to some extent limited because of its liquid form, because of its variable quality, because it is not easily handled, and because it requires special storage facilities and usually special manipulating machinery in commercial manufacturing plants. These disadvantages may be removed (it is stated) by the following method of preparation :—Casein or skimmed milk solids are intimately mixed with the heated molasses in the proportion of 1 to 2 parts by weight respectively, and the product subsequently dried, using preferably the apparatus described in U.S. Patents 1, 298,470 and 1,374,455.

FILM EVAPORATORS. ***Samuel M. Lillie***, of Philadelphia, Pa., U.S.A. *1,536,894.* May 5th, 1925. See U.K. Patent, 201,134.[1]

LEAF FILTER WITH VERTICALLY HANGING ELEMENTS. ***Paul Dehne***, of Freiburg, Germany. *1,547,368.* July 28th, 1925.

Claim 4 : In a filtering apparatus the combination with a casing having a supplying pipe for the matter to be filtered and a removable bottom, of a hydraulic pressure cylinder and piston on the top of said casing, a number of vertically hanging hollow filter elements suspended from said hydraulic pressure piston by a tubular piston rod communicating with said filter elements by a hollow piston placed in the casing, the cross section of which corresponds to that of the casing, the tubular piston rod having a supplying pipe for a

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[1] *I.S.J.*, 1923, 609.

suitable washing, cooling or heating liquid, the stroke of the hydraulic pressure piston being sufficient to move the filter elements into and out of said casing when the bottom has been removed, the elements having detachable discharging pipes for the filtered liquid, and the hydraulic pressure cylinder having a supplying and a discharging pipe for the pressure fluid to said cylinder.

UNITED KINGDOM.

CENTRIFUGAL DISCHARGING DEVICE.* *E. van der Molen*, **of Groningen, Holland.** *238,460.* January 24th, 1925.

Deposited solids, as sugar or the like, are removed from a centrifugal basket by a scraper supported by a guideway over the basket; a coupling device causes the guideway and spindle to oscillate together while the guideway is prevented from rotating with the spindle. The spindle *5* carries the basket *6* within the stationary casing *7* which supports the guide *11* composed of four parallel bars. Two slides *12*, *13* work between these bars on opposite sides of the spindle The slides are connected together by a strip *14* and support the scraper-knife *8* and a plough *9* which directs the loosened material to the opening *10*. To bring the scraper into engagement with the deposited solids the slides are moved along the guide *11* by means of the screw *33*. The casing carries angle pieces *16*, *17* with rubber buffers *18* to prevent the guide from rotating with the basket. The guide *11* also carries two slides *27*, *28* with bearing ends *29*, *30*, each adapted to encircle the spindle *5* through about a quarter of its circumference. The slides are moved to engage the spindle by a screwed spindle *31* so that the basket and scraper maintain a constant relative position during any oscillation. A short scraper may be used and may be reciprocated to cover the full length of the basket; the scraper may be mounted for rotation on a vertical axis to vary the cutting angle. In a modification the means for operating the slides *27*, *28* are coupled with those for operating the scraper, so that the scraper can only be moved into cutting position when the slides are moved to clutch the spindle *5*. In another modification, a two-part ring *48*, Fig. 6, is supported by the guide *11* and carries two perforated lugs to receive coupling pins *49* flexibly attached to the ends of a bifurcated lever *50* which rotates in a vertical plane on a pivot *51* in a bracket on the guide *11*. The end of the lever *50* has rollers engaging in a cam groove in the slide *12* which can be moved to cause the pins to pass through the perforated lugs and engage in holes in the guide *11*. In the retracted position, when the pins are freed from the guide but are left in the lugs, the flexible mounting permits them to oscillate with the ring *48* and the spindle *5*.

FIG 6

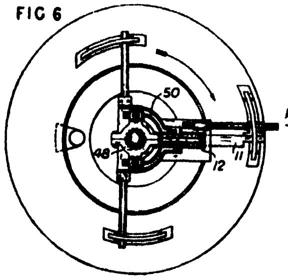


FIG 1

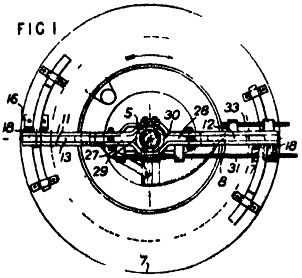


FIG 7

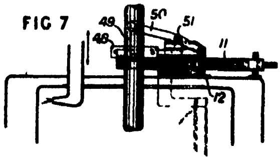
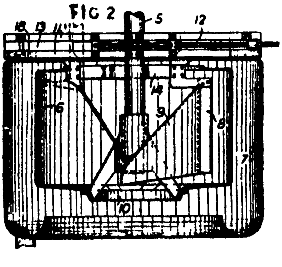


FIG 2



Sugar Crops of the World.

(Willett & Gray's Estimates to November 25th, 1925.)

	Harvesting Period	1925-26. Tons.	1924-25. Tons.	1923-24. Tons.
United States—Louisiana	Oct.-Jan.	195,000	79,002	144,664
Texas	,, ,,	250	450	2,500
Porto Rico	Jan.-June	550,000	589,288	399,975
Hawaiian Islands	Nov.-June	645,500	695,000	626,279
West Indies—Virgin Islands	Jan.-June	7,000	7,200	2,332
Cuba	Dec.-June	5,150,000	5,125,970	4,066,642
British West Indies—Trinidad	Jan -June	55,000	69,628	52,045
Barbados	,, ,,	50,000	53,000	44,109
Jamaica	,, ,,	40,000	42,600	33,431
Antigua	Feb.-July	15,000	17,300	7,860
St. Kitts	Feb.-Aug.	13,000	16,000	10,196
Other British West Indies	Jan.-June	7,500	9,000	4,488
French West Indies—Martinique	Jan.-July	21,000	23,000	17,110
Guadeloupe	,, ,,	28,000	34,722	27,548
San Domingo	Jan.-June	320,000	311,270	229,373
Haiti	Dec.-June	13,500	8,280	5,800
Mexico	,, ,,	175,000	165,223	166,932
Central America—Guatemala	Jan.-June	25,000	24,000	20,850
Other Central America	,, ,,	62,500	65,000	55,281
South America—				
Demerara	Oct.-Dec. and May-June	100,000	100,000	95,494
Surinam	Oct. Jan.	10,000	10,200	10,682
Venezuela	Oct.-June	19,000	19,000	17,488
Ecuador	Oct.-Feb.	18,000	18,700	13,662
Peru	Jan.-Dec.	265,000	310,522	316,904
Argentina	May-Nov.	365,000	246,717	249,162
Brazil	Oct.-Feb.	750,000	812,493	799,931
Total in America		8,900,250	8,853,565	7,420,738
Asia—British India	Dec.-May	2,502,000	2,537,000	3,317,000
Java (1926-27: 2,000,000)	May-Nov.	2,290,000	1,977,490	1,771,772
Formosa and Japan	Nov.-June	478,000	458,836	448,736
Philippine Islands	,, ,,	470,000	581,000	372,332
Total in Asia		5,740,000	5,554,326	5,909,840
Australia	June-Nov.	500,000	435,680	281,859
Fiji Islands	,, ,,	55,000	70,000	58,000
Total in Australia and Polynesia		555,000	505,680	339,859
Africa—Egypt	Jan.-June	107,000	110,000	88,382
Mauritius	Aug -Jan.	206,000	224,710	201,550
Réunion	,, ,,	40,000	51,700	44,132
Natal	May-Oct.	190,000	143,974	181,571
Mozambique	,, ,,	60,000	55,000	56,400
Total in Africa		603,000	585,384	572,035
Europe—Spain	Dec.-June	9,000	8,087	7,871
Total cane sugar crops		15,807,250	15,507,042	14,250,343
Europe—Beet sugar crops	Sept.-Jan.	7,605,000	7,077,791	5,057,761
United States—Beet sugar crop	July-Jan.	775,000	974,185	787,217
Canada—Beet sugar crop	Oct.-Dec.	30,000	36,200	16,500
Total beet sugar crops		8,410,000	8,088,176	5,861,478
Grand total Cane and Beet Sugar	Tons	24,217,250	23,595,218	20,111,821
Estimated increase in the world's production	,,	622,032	3,483,397	1,790,068

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1925. Tons.	1924. Tons.
Total Receipts, January 1st to December 2nd	3,131,261	2,915,641
Deliveries ,, ,,	3,107,034	2,914,505
Meltings by Refiners ,, ,,	3,082,380	2,895,560
Exports of Refined ,, ,,	252,000	178,000
Importers' Stocks, December 2nd	24,227	1,930
Total Stocks, December 2nd	58,688	23,964
	1924.	1923.
Total Consumption for twelve months	4,854,479	4,780,684

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1922-1923 1923-1924, AND 1924-1925.

(Tons of 2,240 lbs)	1922-23 Tons.	1923-24 Tons	1924 25 Tons.
Exports	3,386,494	3,736,359	4,399,231
Stocks	86,266	145,422	460,709
	3,472,760	3,881,781	4,859,940
Local Consumption	108,000	115,000	120,000
Receipts at Ports to October 31st	3,580,760	3,996,781	4,979,940

Havana, October 31st, 1925　　J. GUMA. L MEJER

Beet Crops of Europe.

(Willett & Gray's Estimates to November 25th, 1925.)

	Harvesting Period.	1925-26 Tons.	1924-25. Tons	1923-24. Tons.
Germany	Sept.-Jan.	1,680,000	1,575,684	1,146,891
Czecho-Slovakia	Sept.-Jan.	1,600,000	1,409,703	1,001,049
Austria	Sept.-Jan.	85,000	75,000	47,321
Hungary	Sept.-Jan.	220,000	202,354	122,588
France	Sept.-Jan.	780,000	827,472	490,850
Belgium	Sept -Jan.	380,000	400,105	300,121
Holland	Sept.-Jan.	300,000	329,244	231,923
Russia (Ukraine, etc.)	Sept.-Jan.	950,000	458,375	366,742
Poland	Sept.-Jan.	530,000	494,854	389,995
Sweden	Sept.-Jan.	180,000	135,000	153,890
Denmark	Sept.-Jan.	175,000	140,000	192,358
Italy	Aug.-Oct	200,000	422,000	351,102
Spain	Sept.-Jan.	225,000	260,000	185,063
Switzerland	Sept.-Jan.	6,000	5,906	5,500
Bulgaria	Sept.-Jan.	38,000	39,758	26,566
Roumania	Sept.-Jan.	85,000	86,256	71,826
England	Sept.-Jan.	64,350	23,730	13,280
Other Countries	Sept.-Jan.	106,650	192,350	50,696
Total in Europe		7,605,000	7,077,791	5,057,761

United Kingdom Monthly Sugar Report.

Our last report was dated the 9th of November, 1925.

During the whole period under review the market has shown a steady appearance and generally prices are higher than a month ago. Sentiment seems to be changing in favour of sugar and from all appearances prices were pitched too low at 2 cents or under for Cubans.

The London Terminal Market has been active and a large business has been transacted. The daily registrations on the average have continued on a higher scale than since the inception of the contract. Large buying orders have come into the country for speculators, and hedging and covering operations have helped to make the marked liquid. About 15,000 tons were tendered on November but all the sugar was stopped very quickly and had little or no effect on the market. November was finally liquidated at 14s. 4½d. Heavy liquidations have taken place in December, holders in most cases transferring to March, May or August. December sold from 13s 6d. up to 14s. 6d. and down again to 13s. 8¼d Up to the present about 20,000 tons have already been tendered on December contracts. March sold from 14s. 3¾d. to 15s 3¾d. to 14s. 4½d., May from 14s. 7½d. to 15s. 6d. to 14s 6¾d., whilst August fluctuated from 14s. 11¼d. to 16s. to 15s. The latest prices are December 13s. 8¼d., March 14s. 3d., May 14s. 6d., August 14s 11¼d.

Trading in actual sugars has been rather slow and after the reaction in prices from the highest point the trade continued to pursue their hand to mouth policy. No export trade has been done. Ready Granulated, which was fairly plentiful at the outset, has been scarce and in good demand since December 4th when the Elbe Navigation was officially declared closed. Various Dutch and Czecho marks sold from 13s. 10½d. to 14s. 10½d. The latest price is 14s. 9d. There is still little demand for forward as the premiums are considered too high. American Granulated has not been so abundant and has been dealt in from 14s. 6d. to 15s. 3d c.i.f. U.K. Polish and Hungarian Crystals are not pressing for sale in this country, sugar from Hungary having found an outlet in India. The Java Market has improved and India has been a big buyer. Small quantities of next May/June shipment have been sold to the U.K. from 15s. to 15s. 9d. c.i.f.

Spot sugars have been plentiful owing to the tenders on the terminal market. Dutch, Czecho and American Granulated have been sold from 27s. to 27s. 10½d. to 27s. 4½d. duty paid. White Javas and Mauritius have been sold from 24s. 6d. to 26s. 6d. according to quality.

Large quantities of Home Grown Sugars have been marketed chiefly by Kelham, Cantley, Ely and Anglo-Scottish Factories. Last week the Kidderminster Factory started; it principally intends to supply the Birmingham area. These home grown sugars have been sold from 27s. 6d. to 28s. to 27s. 3d., subject to the usual rebates

The British Refiners have done a good business and advanced their prices by 3d. per cwt. on the 13th November, by a further 3d. on the 25th November, and again by 3d. on the 26th November. The latest prices are No. 1 Cubes 32s. 6d., London Granulated 28s. 10½d.

Only a fair business has been done in raws to the British Refiners; amongst the sales were Cuban 96 per cent. at 11s. to 11s. 7½d. c.i.f., Mauritius Crystals from 15s. 6d. to 16s. 3d. c.i.f., and B.W.I. from 14s. 3d to 15s. 3d. c.i.f.

In New York a good business has been done in raws and at one time up to 2½ cents was paid, but the latest price is $2\frac{5}{16}$. The Futures Market has fluctuated considerably, especially for December delivery, but the quotations to-day are on a higher level than a month ago.

Reports of the Cuban crop are contradictory. The complaints as to drought seem to be founded on fact as the official rainfall for October is given as 2 ins, against 9 ins. last year. Various forecasts of the outturn of the crop have been estimated from 4,800,000 tons to 5,150,000 tons. GUMA MEYER has to-day brought out his first official estimate of 5,373,714 tons, but up to the time of writing HIMELY has not issued one. Stocks at the outports are now only 230,000 tons more than last year. 20 Centrals are now reported to have started work.

The weather on the Continent has improved for the harvesting, but F. O. LICHT has reduced his previous estimate for statistical countries by 123,000 tons, although at the same time he increases Russia by 50,000 tons, making a net reduction of 73,000 tons.

21, Mincing Lane,
London, E.C. 3.
December 10th, 1925.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

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(D. O. T. Report) *Department of Overseas Trade Report;*
(Am. Comm Report) *American Commerce Report.*]

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